THE IMPACT OF RECYCLED WATER ON WATER QUALITY IN COYOTE CREEK IN SAN JOSE, CALIFORNIA IN 2001

Prepared for the City of San Jose, California

By

Jane Hopkins, M.S.C.E.

Rhea L. Williamson, Ph.D., San Jose State University Professor

Robyn Simonsen, M.S. Candidate

San Jose State University

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Introduction: Table of Contents

EXECUTIVE SUMMARY

Coyote Creek provides warm water habitat to a variety of aquatic species. Following implementation of stream augmentation activities, Coyote Creek may provide cold water habitat as well. Additions of recycled water are expected to be beneficial in several ways, including the flushing of fine particulates, the removal of debris, an increase in flow and, potentially, the provision of habitat to anadromous fish. Deleterious impacts of increased flows may include increased loading of dissolved inorganics (*e.g.*, nutrients and metals such as zinc) and incidences of algae blooms (resulting in low concentrations of dissolved oxygen, elevated pH and increased concentrations of un-ionized ammonia). Specific conclusions based on data generated in 2000 and 2001 follow:

- Nitrate-nitrogen was the dominant form of nitrogen throughout the monitoring period at all stations. The nitrate concentrations were high, particularly during the time period proposed for augmentation. The lowest concentrations measured were sufficient to saturate algae enzyme systems.

- Maximum planktonic algae growth occurred in the late winter/early spring months, when nitrogen concentrations are low; additions of nutrient-rich water during this time period could enhance planktonic algae growth.

- Total ammonia concentrations were higher in 2001 than in 2000. Concentrations at sites above Watson Up were typically less than the Practical Quantitation Limit (PQL), whereas from Watson Up to Muni Golf, elevated total ammonia concentrations were common.

- The temperature and pH dependent Criterion Continuous Concentration (CCC) applicable when fish early life stages are present (USEPA, 2000) determines the calculated total ammonia allowable in a body of water (Federal Register, 1999). Using the highest pH (8.4) and the highest temperature (22^{o}C) measured during the study period, the total ammonia concentration in Coyote Creek did not exceed the CCC of 0.796 mg N/L (Federal Register, 1999).

- During sampling events, the CCC for total ammonia was never exceeded. However, conditions of algae growth, increased light penetration, variability in sampling time (seasonal and diel), and numerous other factors could result in minor increases in pH and/or temperature that would cause the ammonia levels to exceed the criterion (CCC). Under existing creek conditions, the potential to exceed the ammonia criterion in Coyote Creek does not appear to be great since sites with the highest ammonia concentrations (*e.g.,* Muni Golf) typically did not have the highest pH values. Nonetheless, creek conditions following augmentation have a greater potential for ammonia concentrations to exceed the CCC.

- Increased loading of nitrate-nitrogen, followed by transformation to total ammonia nitrogen could result in increased toxicity in Coyote Creek under conditions of increased temperature and pH.

- Attached algae were not significant at sampling sites where the substrate was primarily sand and silt. The presence of gravel and cobbles within a reach generally resulted in the presence of attached algae, however nuisance levels were never observed. Attached algae biomass is low relative to other urban creeks; growth appears limited by substrate availability for attachment or sunlight.

- Planktonic algae concentrations at some sites (*e.g.,* Hellyer and Singleton) were in the range of a mesotrophic to eutrophic system. Stations characterized by low flow velocity had elevated concentrations of phytoplankton, possibly because of increased time for growth within a reach.

- A decrease in planktonic chlorophyll-a was measured at all creek sites in 2001 relative to 2000, with the lowest concentrations of planktonic algae biomass measured at Stonegate and Watson Up. Concentrations increase at Watson Down and Muni Golf, in response to elevated concentrations in the tributaries.

- In general, many sites had oxygen concentrations lower than the minimum concentration required for a cold water fish habitat (7.0 mg/L as O_2 for tidal waters in the Bay downstream of Carquinez Bridge, CRWQCB-SFBR, 1986). This was particularly evident at Watson Up.

In summary, the discharge of recycled water into Coyote Creek could result in increased algae growth, increased nitrogen concentrations, and under certain conditions, increased concentrations of un-ionized ammonia. In addition, increased discharge into Coyote Creek could transport sediment fines downstream, resulting in an increase in available substrate for attached algae growth. It is important to note, however, that considerable gaps in knowledge about creek-specific algae nutrient limitations, seasonal (year-round) and diel variability, and discharges from unknown sources to Coyote Creek limit predictions on the impact of recycled water on Coyote Creek ecology. Given these limitations in data availability, several data gaps need to be addressed. They are:

- Assessment of algae growth potential
- Determination of diel and seasonal variability
- Determination of discharge variability and of impacts from storm drains
- Studies relating to the development of a comprehensive objective or management plan that includes factors that control algae growth
- Investigation of discharges between Stonegate and Watson Up for the potential discharge of organic and/or inhibitory substances

THE IMPACT OF RECYCLED WATER ON WATER QUALITY IN COYOTE CREEK IN SAN JOSE, CALIFORNIA IN 2001

INTRODUCTION

This report summarizes data collected in the second year of baseline data collection on Coyote Creek, California. Sampling began in July of 2001 and continued through November of 2001. Data collected in 2001 from Coyote Creek and its tributaries are assessed and compared to data collected in 2000. Coyote Creek originates in the Diablo Mountains and flows northward through Santa Clara County, California to San Francisco Bay. It flows through urban and industrial areas into the South San Francisco Bay. Beneficial uses of the creek include industrial process supply, water contact recreation, ocean commercial and sport fishing, warm fresh water habitat, preservation areas of special biological significance, wildlife habitat, marine habitat, and fish migration. In addition, navigation is considered a potential beneficial use of the creek (CRWQCB-SFBR, 1986). Coyote Creek currently provides warm water habitat to a variety of aquatic species. Following implementation of stream augmentation activities, Coyote Creek may provide cold water habitat as well.

PROJECT GOALS AND TASK DESCRIPTIONS

The goal of this project was to continue to supplement efforts undertaken by the City of San Jose in determining the impact of recycled water on water quality and algae growth in Coyote Creek. The focus was on assessing the effects of augmentation using recycled water on the loading of nutrients and resulting changes in algae biomass, pH, dissolved oxygen, and un-ionized ammonia concentrations in the Creek. Two objectives were considered in assessing the effects of augmentation: (1) to ensure that the overall goal of protecting and preserving the beneficial uses of Coyote Creek is met, and (2) to enhance the habitat of Coyote Creek.

The following is a discussion of the specific tasks performed to assess the potential impact of additions of recycled water to Coyote Creek.

Task 1: Routine Water Quality Sampling

The monitoring plan used during the first phase of this study was evaluated and revised with assistance from personnel of the City of San Jose (CSJ). The monitoring plan, in coordination with existing project monitoring plans, was developed to document water quality conditions and changes in algae growth and impact. Year round sampling was recommended in order to document peak levels of algae in the creek, which our data from 2000 indicated occurred in the early spring. Records of elevated algae growth during the wet season could then be compared to changes in growth following augmentation, if applicable. The CSJ staff, however, limited sampling to that period when recycled water would be used to augment flow in Coyote Creek. It was recommended by Williamson and Hopkins (2001) that the revised plan begin as soon as possible, with data collection starting in March 2001 at the latest. Unfortunately, due to administrative delays, field sampling at several monitoring stations did not begin until July 2001. Data were collected through November of 2001 on a monthly basis in conjunction with fieldwork conducted by the City of San Jose.

Task 2: Draft Final Report

The draft final report summarized and integrated the results of Task 1. The report was submitted to the CSJ in March of 2002. Final comments were received in late April of 2002.

Task 3: Final Report

The final report reflects comments made on the draft report.

REPORT STRUCTURE

This report is structured into chapters that incorporate the specific tasks identified in the proposal and summarized above. Each Chapter has a separate Table of Contents and List of Tables and Figures. The document refers to information, data, analytical results, and conclusions previously detailed in Williamson and Hopkins (2001). Information in that report is not repeated in this report. The 2002 report functions as an addendum/update to the 2001 report per agreement with CSJ staff (P. Schafer, 2001). This allowed a greater emphasis on making data comparisons between the 2000 and 2001 monitoring seasons (Chapter III).

Chapter I is an introduction to Coyote Creek. It includes descriptions of the sampling sites, with particular emphasis on the two additional stream sites identified in collaboration with personnel of the San Jose/Santa Clara Water Pollution Control Plant (SJ/SC WPCP). The new sites are located in Coyote Creek above Hellyer Park at Bernal Road, and near Metcalf Road. Changes made to the existing sites are also described. Historical water quality data were not available for the new Coyote Creek sites.

Chapter II summarizes changes made to the materials and methods used in 2000 that were implemented in the 2001 sampling season. Detailed methods and materials used in 2000 are provided in Williamson and Hopkins (2001). These methods, including the 2001 updates, were used in assessing the potential impacts of recycled water on water quality and algae growth in Coyote Creek.

Chapter III provides the results and discussion of the water quality sampling program implemented between July and November of 2001. Physical, chemical, and biological results are summarized and compared to the data collected in 2000. In the biological section, the algae and macrophytes at each site are described. Riparian vegetation was not monitored in 2001, and data are not reviewed further. Chapter III also includes a discussion of water quality trends at all sites.

Chapter IV summarizes the conclusions and provides recommendations.

LITERATURE CITED

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Chapter I. Descriptive Information Related to Coyote Creek and Its Tributaries

Chapter I: Table of Contents

Chapter I: List of Tables and Figures

CHAPTER I. DESCRIPTION OF COYOTE CREEK AND ITS TRIBUTARIES

In this chapter, the natural setting, vegetation, and hydrology of Coyote Creek and its tributaries are described. New and deleted sites are identified. Site descriptions, driving directions to each site, and site-specific human activities observed are provided. A brief physical description of each of the sampling sites is also included.

NATURAL SETTING AND VEGETATION

In this section, the natural setting, vegetation, and existing hydrology of Coyote Creek and its tributaries are reviewed.

Natural Setting

The climate of Coyote creek is characterized as Mediterranean. The elevation of the study site is approximately 125 feet, and the watershed ranges from more than 3,000 feet upstream to sea level at the southern point of the San Francisco Bay. Coyote Creek begins in the Diablo Mountains and flows northward into the San Francisco Bay. The headwaters of Coyote Creek originate in a rural land use area, however the study sites are all located in urban areas. It flows through densely populated suburban residential areas, city parks, industrial areas and near busy highways, *e.g.*, Highway 101 and Highway 880. For these reasons, Coyote Creek is characterized as an urban creek. Despite the urban and industrial setting, the creek is bordered along most of its length by a dense riparian corridor. The majority of the sites have well-developed riparian vegetation, plenty of shade, and slow-moving, shallow, turbid water.

Vegetation

Common trees in the riparian corridor include Coast Live Oak, Western Sycamore, Blue Elderberry, Box Elder, Fremont Cottonwood, Yellow Tree Willow, and Red Willow (Kook, 2000; Jones and Stokes, 2000a). The tree most often observed next to the creek is cottonwood; Buckeye is also noted. Understory plants observed at several sites include mugwort, Western Virgin's Bower, California Blackberry, California Wild Rose, Mulegat, poison oak and *Leymus tritioides* (common name unknown). A type of bamboo, aquatic reeds, and a yellow-flowering macrophyte, since identified as *Ludwigia*, grows immediately adjacent to and in the creek.

Hydrology

The average annual rainfall in the Coyote Creek watershed is 21.2 inches (USEPA, http://www.endeavor.des.ucdavis.edu/newcara/basin.asp). This precipitation results in direct and indirect recharge of Coyote Creek. Runoff into Penitencia Creek and San Miguelita Creek converges with Coyote Creek. Flows in San Miguelita Creek are supplemented by Silver Creek prior to convergence with Coyote Creek. Jones and Stokes (2000a) also lists San Felipe Creek as a tributary stream to Coyote Creek. Numerous storm drains discharge into Coyote Creek near several sampling sites (*e.g.*, Singleton, Watson Down and Muni Golf). Releases from Coyote Reservoir and Anderson Reservoir also supplement the flow in Coyote Creek. Information on releases from Anderson Reservoir is provided in Williamson and Hopkins (2001).

ANTICIPATED DISCHARGE AFTER AUGMENTATION

The City of San Jose may augment flows in Coyote Creek between May and November, depending on stream conditions. The project design sets a maximum release volume of eight million gallons per day (mgd), which should result in approximately double the average dry weather flow in Coyote Creek at the release site. At Hwy 237 (a tidally influenced reach of the creek), the recycled water should increase the average dry weather flow by 50 percent (Jones and Stokes, 2000b).

In 2000, the proposed release site was on Coyote Creek at a location adjacent to the Singleton landfill. In 2001, proposed release sites as far south as Metcalf Road were studied in response to input from various stakeholders. A key stakeholder issue was the location of a good spawning area that would not strand fish. The projected construction of the Calpine Power Plant near Metcalf Road and the potential extension of the recycled water pipeline to that location would make discharge at that site possible. The actual location of the release site has not been determined.

SITE DESCRIPTIONS

The sites monitored as part of the stream augmentation project of Coyote Creek in San Jose, California are described in this section. The sites are located as indicated on Figure I-1. Note that in 2001, the Charcot and Kelly Park sites were dropped from the sampling plan and the Bernal and Metcalf sites were added to the sampling plan. Table I-1 identifies the sites by location and gives a brief directive to each site. This section also provides a description of each sampling site with a brief description of stream morphology.

Eight Coyote Creek sites and two tributary sites were monitored by SJSU between July and November of 2001. Three creeks flow into Coyote Creek down gradient of the Metcalf site: Penitencia Creek, San Miguelita Creek, and Silver Creek (which flows into San Miguelita Creek before it converges with Coyote Creek). The sampling sites on Coyote Creek near these tributaries were selected to allow for identification of the impact of the tributaries on the water quality parameters of Coyote Creek. Note that the single site at San Miguelita Creek represents the combined impact of San Miguelita Creek and Silver Creek on Coyote Creek water quality. The recycled water was monitored during the 2000 and 2001 sampling periods at the Transfer Pump Station (TPS, near the San Jose/Santa Clara Water Pollution Control Plant) and at a storage tank located further up the pipeline (indicated as “Reservoir” in Fig.I-1) by CSJ staff.

Figure I-1. Sites Monitored as Part of the Stream Augmentation Project of Coyote Creek in San Jose, California in 2000-2001. Bernal and Metcalf Were Not Monitored in 2000.

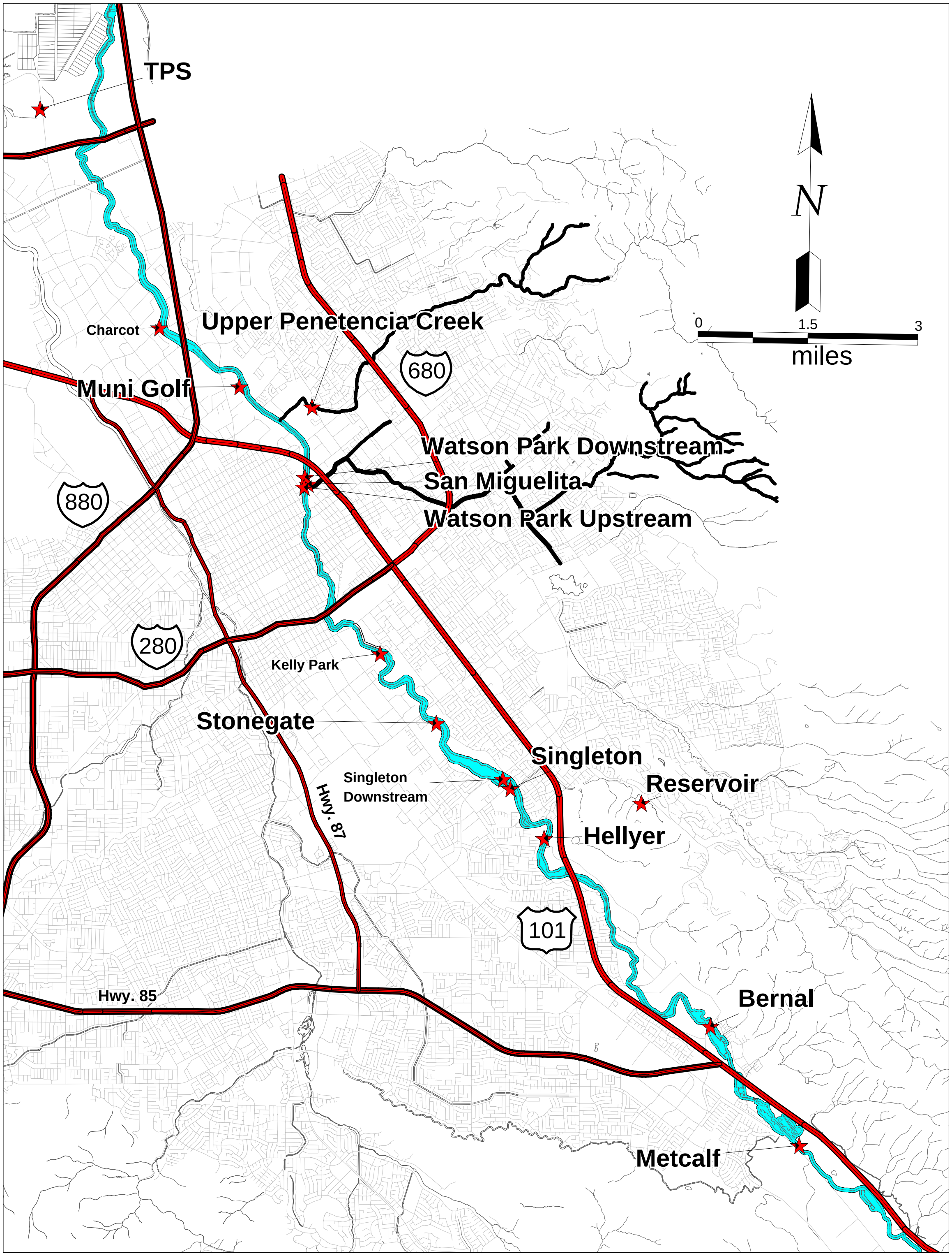

Table I-1. Directive Information for Each Sampling Site Surveyed for the 2001 Coyote Creek Stream Augmentation Project located in San Jose, California

SITE NAME	SITE LOCATION
Muni Golf	Exit Hwy 101at the Oakland 13th street exit. Turn right (north) on 13th St. (turns into Oakland Avenue) to Corie Avenue. Turn right on Corie Avenue into the small loop. Beyond the loop is a locked gate and an access road to SCVWD levees. Follow road to the new construction area and park. Climb down the steep hill toward Coyote Creek. The site is located above the storm drain.
Penitencia Creek	Exit Corie Ave. heading left (south) on 13th St. to Commercial St. Turn left onto Commercial St. Go to the lights and turn left onto Berryessa Road. Turn right onto King Road. Park at the little footbridge on the left side of the road (near Cambridge Drive). Walk upstream on the left to the clearing between tree clusters. In 2001, the site was moved 100 feet downstream of the original location.
Watson Down	Continue south on King Road. Turn right onto McKee Rd. Cross Julian Bridge, which crosses over Hwy. 101. Turn right before the railroad crossing, just at the end of the overpass. Quickly turn left and right onto Woosler St. Drive through the gate at the left of the Kellogg's plant (keys required). Walk past the confluence of Coyote Creek and San Miguelita Creek and across the merged streams. Walk downstream to an area with carts, drums and trash downstream and a field drain from the adjacent park. The site is located above the storm drain.
San Miguelita Creek	Walk upstream along Coyote Creek approximately 100 ft up gradient from the confluence of Coyote Creek and San Miguelita Creek.
Watson Up	Walk above confluence of Coyote Creek and San Miguelita Creek. The flagging is on the left side as you look upstream on Coyote Creek.
Stonegate	Return to McKee Rd., drive on 101 South. Exit at Tully Rd., going right (west). Turn left on Sherlock. Pass the school, turn right on Gassman Road. Park at Stonegate Park. Walk along the fence to the opening, then down the steep trail to the creek. Follow the trail to the right (downstream). The stakes are located at a site where the creek widens. There are 3 huge cottonwoods located on the east bank.
Singleton	Continue along Gassman Rd., turn right onto Capitol Expressway. Turn left on Senter Rd. Turn left onto Singleton Rd. Drive through the gate at the landfill and park near the bridge that crosses Coyote Creek. Walk approx. 500 feet upgradient along Coyote Creek on the right (west side).
Hellyer	Exit Singleton Road, turn left onto Senter Rd. to Hellyer Road. Turn left and continue to Hellyer Park. Turn left into the park and park in the lot to the left. Walk north approx. 50 yards to a trail leading to the creek. The site is marked by an "island of vegetation" on the right side, looking upstream.
Bernal	Take Hwy 101 south to Bernal Road exit. Go east on Bernal Road approx. 0.25 miles. Park at the corner near the overpass. Walk upstream under the overpass. Sample just below the pool area above the overpass.
Metcalf	Take Bernal Road east. Exit beyond the Hwy 101 interchange. Turn left on Monterey Hwy at the bottom of the ramp, heading south. Turn left on Metcalf Road, and an immediate right onto the bike path (lift out the center post blocking path access). Drive slowly along the bike path approx. 0.4 miles to the flagged large walnut tree. Walk through brush to the creek. There is a steep bank on the right, and a flat area on the left. Stakes are located along tree roots on the right and on the vegetated island on the left.

Muni Golf

The Muni Golf site lies between Hwy 880 and Hwy 680 near Oakland Road. There is a storm drain on the left side just above the sampling site. There are areas of exposed rock at this site, which consist of 95 percent cobble and 5 percent boulder. The substrate was typically covered with a 1-2 cm layer of silt. The depth was consistently shallow on the left side and deeper on the right side throughout 2000-2001. Turbidity was such that the stream bottom on the shallow side was obscured. The green filamentous alga, *Cladophora*, was always present at this site during sampling events. Physical characteristics of the site are summarized in Table I-2 for 2000 and 2001. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-2. Range of Physical Characteristics at Muni Golf for June-November, 2000 and July-November, 2001.

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2000	100/0	1.1-1.2	17.2	1.4-2.0	15.6-22.9	83-91
2001	100/0	1.0-1.3	14.9-18.0	1.1-1.8	10.0-21.5	89-92

* bc/gs indicates boulder and cobble / gravel and sand or silt

Penitencia Creek

Penitencia Creek was sampled at a location near the intersection of King Street and Berryessa Road. In 2001, the site was relocated approximately 100 feet downstream in order to reduce impacts by a homeless man who had set up housekeeping adjacent to our sampling location. Overall, the water depth was consistently less than or equal to 0.5 feet deep in 2000 and 2001. Stream velocity was much faster than that measured at most of the Coyote Creek sites. Water clarity was variable. In 2000, the canopy cover measured from early June to early November was one of the lowest of the sites, with lowest values measured following leaf loss in November. Canopy cover at the new site was higher ranging from 50 to 64 percent. The green filamentous alga, *Cladophora*, was always present at this site during sampling events. In 2001, the condition of the algae declined; in July it was described as having a red-brown color and appeared to be in the process of decaying. Physical characteristics of the site are summarized in Table I-3. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-3. Range of Physical Characteristics at Penitencia Creek for June-November, 2000 and July-November, 2001.

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2000	75/25	0.35-0.50	5.0-7.0	0.7-1.5	1.7-2.9	20-40
2001**	90/10	0.20-0.45	9.0-10.8	0.5-1.4	0.8-3.7	50-64

* bc/gs indicates boulder and cobble / gravel and sand or silt
** site moved approx. 100 feet downstream, where fence changes wood type

Watson Down

The Watson Down sampling site is located adjacent to Highway 101 and just below the Kellogg's plant and a school facility. It is located on Coyote Creek immediately below the confluence with San Miguelita Creek. Steep, barren banks border the creek. Considerable amounts of trash and debris were present throughout the sampling period, which accumulated over the course of the sampling periods to form debris dams. Downstream of the site there were shopping carts and 55 gallon drum containers. Tents were observed along the right side of the creek and homeless people were often observed along the banks. Ten feet above the transect, a 1.5 foot diameter storm drain intermittently discharged a foamy, often cloudy liquid into Coyote Creek. In early August of 2000, the depth of the water in the storm drain was two inches; consequently, the transect was moved from approximately two feet above the storm drain to its current location.

The substrate was 100 percent sand and silt. The creek flow velocity was typically slow moving and the brown water was so turbid that often the flow meter could not be observed at six inches below the water surface. The site is heavily shaded. The green filamentous alga, *Cladophora*, was never present at this site during sampling events. Physical characteristics of the site are summarized in Table I-4. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-4. Range of Physical Characteristics at Watson Down for June-November, 2000 and July-November, 2001

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2000	0/100	1.9-2.0	20.3	0.3-0.9	11.2-15.8	70-92
2001**	0/100	1.65-2.0	24.0-27.0	0.3-0.4	11.1-15.4	60-94

* bc/gs indicates boulder and cobble / gravel and sand or silt
** site moved approx. 10 feet upstream, above the storm drain

San Miguelita Creek

The San Miguelita Creek sampling site is located adjacent to Highway 101 and just below the Kellogg's plant and a school facility. Heavy erosion was evident along a dirt road located on a steep slope above the creek. The streambed profile was very jagged due to the presence of concrete rubble that was often partially exposed. The maximum depth at this site was consistent at 0.7 to 0.8 feet in 2000 and slightly deeper (0.8 to 1.2 feet) in 2001. The depth was quite variable across the creek width, which was generally around 16-17 feet. Velocity at this site was generally faster than that measured at the Coyote Creek sites. Water clarity was variable. Canopy cover was scant, with an average of four percent measured during the sampling period. The green filamentous alga, *Cladophora*, was always present at this site during sampling events. Physical characteristics of the site are summarized in Table I-5. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-5. Range of Physical Characteristics at San Miguelita Creek for June-November, 2000 and July-November, 2001.

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2000	75/25	0.7-0.8	17.1-18.0	1.0-1.5	8.4-12.2	1-7
2001	75/25	0.8-1.2	16.0-19.0	0.4-0.8	3.3-8.2	0

* bc/gs indicates boulder and cobble / gravel and sand or silt

Watson Up

The Watson Up sampling site is located adjacent to Highway 101 and near the Kellogg's plant and a school facility. It is located on Coyote Creek immediately above the confluence with San Miguelita Creek. Flat, muddy banks border the creek. Considerable amounts of trash and debris were present throughout the sampling period, which accumulated over the course of the sampling period to form debris dams. A sleeper sofa, scrap metal, other garbage, debris, and fallen branches were seen in the creek near the monitoring transect. In August of 2001, the transect was moved approximately 10 feet downstream of the 2000 transect to avoid the trash.

The substrate was 100 percent sand and silt. Sampling in the creek resulted in a dark, muddy, odiferous (hydrogen sulfide) plume in 2000 and 2001. The creek was approximately two feet deep in the middle and just over 16 feet wide in 2000. In 2001, the width increased to 20 feet. Creek flow velocity was typically too slow to measure with the flow meter. In addition, the water was always too turbid to see either the flow meter or the creek bottom. Canopy cover at this site was high, with greater than 85 percent cover typical. The green filamentous alga, *Cladophora*, was never present at this site during sampling events in 2000. In July, 2001, tufts of *Cladophora* were observed along the waters edge. Physical characteristics of the site are summarized in Table I-6. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-6. Range of Physical Characteristics at Watson Up for June-November, 2000 and July-November, 2001.

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2000	0/100	1.8-2.3	16.3-16.6	0.1-0.3	1.8-7.8	85-95
2001**	0/100	1.7-3.7	19.5-20.1	0.1-0.3	5.1-13.9	86-95

* bc/gs indicates boulder and cobble / gravel and sand or silt
**In August, 2001, the transect was moved 10 feet downstream to avoid the trash.

Stonegate

The Stonegate sampling location lies halfway between Tully Road and Capitol Expressway and within a mile of Highway 101. This site is below a public park and near an elementary school. Discarded 55-gallon drums and shopping carts were observed in the creek at the site. The substrate was fine sand interspersed with occasional cobbles. The maximum creek depth was always under two feet deep and the width was approximately ten feet. The width at this site was obscured by dense aquatic vegetation growing along both banks. Just above the transect, the creek narrowed and below the transect it widened. This resulted in variable physical conditions. Flow velocity was variable and affected by the removal of a logjam just downstream of the transect location in 2000. Water clarity was typically too turbid to see the bottom of the creek.

Canopy cover was typical of Coyote Creek; the average was 82 percent. The green filamentous alga, *Cladophora*, was often present at this site during sampling events. Growth was restricted to the cobbles. Physical characteristics of the site are summarized in Table I-7. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-7. Range of Physical Characteristics at Stonegate for June-November, 2000 and July-November, 2001.

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2000	10/90	1.6-1.8	10.0-10.4	0.4-0.7	4.8-8.0	67-92
2001	10/90	1.5-2.7	9.5-11.4	0.3-0.6	2.7-6.4	45

* bc/gs indicates boulder and cobble / gravel and sand or silt

Singleton

The Singleton site is located 0.75 miles west of Highway 101 and 0.25 miles southeast of Capitol Expressway. The Singleton landfill is on the east side of the site. A large storm drain, also on the east side of the site, discharged runoff into the creek on most sampling dates. Below this discharge point, dense blooms of algae were common. The sampling location was approximately 500 feet above the designated discharge point and 75 feet above the storm drain. The substrate was nearly 100 percent sand and silt, with small areas of gravel and cobbles. Disturbance of the creek resulted in a dark, muddy, odiferous (hydrogen sulfide) plume. Coyote Creek was very wide at this site. In addition, this site was the deepest of all the sites, with a maximum depth of 3.1 feet measured in the middle of the creek. The creek flow velocity was too slow to measure with the flow meter. The water was also extremely turbid. In 2001, flow velocity, creek width, and creek depth were not measured.

Canopy cover at this site was variable, with 50 percent cover typical in the middle of the transect. The canopy cover was the lowest of all the Coyote Creek sites, due in part to its width. Tree branches do not extend over the middle of the creek at this location, despite heavy riparian vegetation along both banks. The green filamentous alga, *Cladophora*, was present just below the storm drain down gradient from the transect, but never along the transect. Dense mats of macrophytes grew along both banks toward the middle of the creek. Physical characteristics of the site are summarized in Table I-8. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-8. Range of Physical Characteristics at Singleton for June-November, 2000 and July-November, 2001.

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2000	0/100	2.7-3.1	47.9-48.9	0.07	6.4-6.8	56-65
2001	0/100	NA	NA	NA	NA	50

* bc/gs indicates boulder and cobble / gravel and sand or silt

Hellyer Park

The Hellyer Park site is 0.5 miles west of Highway 101 and 0.75 miles southeast of Capitol Expressway. In 2001, the transect was relocated approximately 30 feet downstream of the 2000 site where the creek widens into a pool. The substrate at both locations was a mixture of small cobble and large gravel. Water velocity at the site ranged between 1.4 to 2.2 fps. Turbidity tended to be lower than most of the other downstream sites.

Canopy cover at the Hellyer site was variable as a function of leaf loss, with 80 to 93 percent cover measured in the middle of the transect. The green filamentous algae, *Cladophora*, was always present at the site. Physical characteristics of the site are summarized in Table I-9. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-9. Range of Physical Characteristics at Hellyer for June-November, 2000 and July-November, 2001.

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2000	50/50	0.6-0.7	19.0	0.7-0.8	5.9-6.2	78-93
2001**	50/50	0.4-0.8	7.0-9.2	1.4-2.2	2.6-7.1	80-93

* bc/gs indicates boulder and cobble / gravel and sand or silt

**In 2001, the transect was relocated 30 feet downstream of the 2000 site

Bernal

The Bernal site is south of Hellyer Park, off of Hwy 101. Bernal is one of the two new creek sites sampled in 2001. The site is located along Coyote Creek, under the Bernal Road Bridge. The creek changes dramatically at this location from a riffle area to a pool with large cobbles and boulders that narrows in to a linear creek. The substrate is a mixture of small cobble and large gravel. In July, the substrate was covered with brown detritus that was almost gone by August. Water velocity at the site ranged from 1.7 to 2.5 fps. Turbidity tended to be lower than most of the other downstream sites.

Canopy cover at this site was misleading. The site is located under the bridge, so it is often shaded 100 percent by the bridge but also experiences direct unshaded sunlight (zero percent canopy cover). The green filamentous algae, *Cladophora*, were always present at this site reaching lengths of almost four feet in October and November. Physical characteristics of the site are summarized in Table I-10. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-10. Range of Physical Characteristics at Bernal for July-November, 2001.

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2001	50/50	0.4-0.9	8.0-12.2	1.7-2.5	10.3-14.7	80-90

* bc/gs indicates boulder and cobble / gravel and sand or silt

Metcalf

The Metcalf site is located further south of Bernal Road off Metcalf Road. The site used by City of San Jose personnel to collect samples was too deep for a transect to be established. In addition, this reach of the creek is divided into islands that alter seasonally and divide the flow, making assessment difficult. Therefore, another site, further upstream was established. The substrate at the site was a mixture of small cobble and large gravel. Water velocity at the site ranged from 0.8 to 1.1 fps. Turbidity tended to be lower than most of the other downstream sites.

Canopy cover at the Metcalf site was variable as a function of leaf loss, with 78 to 93 percent cover measured in the middle of the transect. The green filamentous algae, *Cladophora*, was always present at this site, with long filaments of three to five feet long measured in July of 2001. Physical characteristics of the site are summarized in Table I-11. Additional site specific data are described in Chapter III and detailed in Appendix III-B.

Table I-11. Range of Physical Characteristics at Metcalf for July-November, 2001.

Year	Substrate Type (bc/gs*)	Maximum depth (feet)	Width (feet)	Velocity (fps)	Discharge (cfs)	Canopy Cover (%)
2001	50/50	1.5-1.7	16.3-17.3	0.8-1.1	14.4-19.3	85

* bc/gs indicates boulder and cobble / gravel and sand or silt

Recycled Water Stations

Recycled water samples and water quality data were collected by City of San Jose personnel between June and November of 2001. Samples were collected at the Transfer Pump Station (TPS) located adjacent to the San Jose/Santa Clara Water Pollution Control Plant and at a storage tank further up the pipeline (designated as “Reservoir in Fig. I-1). The recycled water was characterized by samples/data taken at TPS only.

SUMMARY OF OUTSIDE HUMAN ACTIVITIES AT EACH SITE

Coyote Creek flows through a landscape having a wide range of land uses, including open fields, industrial, recreation, urban, and agriculture. As such, the creek is utilized by a wide range of individuals for many purposes. During sampling activities, numerous human related activities were recorded. Some of the observed activities have a deleterious impact on the quality of the water sampled. For example, use of the creek for swimming, wading, and rope swinging during or prior to sample collection could result in elevated turbidity measurements. Elevated total and fecal coliform numbers may be associated with a high level of human activity (*e.g.*, fishing) and the use of the riparian corridor along the creek as a living space (homeless camps). When sampling, if human activities were on going, sampling was postponed to a later time. A summary of the activities observed during the study period at all of the sites is provided in Table I-12.

Table I-12. Summary of Activities for Each Sampling Site Surveyed for the 2000-2001 Coyote Creek Stream Augmentation Project located in San Jose, California

SITE NAME	SUMMARY OF ACTIVITIES
Muni Golf	Residents of the trailer park walk dogs along the road. On the right side, there is a golf course. Construction ongoing on the left side; stream diversion occurred in September.
Penitencia Creek	A homeless encampment used by several people is just upstream of the site: a make-shift toilet is located next to the stream above the encampment. Local residents were observed strolling and bicycling on the road above the stream.
Watson Down	Trash, shopping carts, and tires are disposed of in the creek. A storm drain discharges into the creek. A rope swing hangs over the middle of the creek. Tents and boxes of clothing were dumped in the vicinity. Glass bottles are abundant. Children and pets playing in and around creek.
San Miguelita Creek	Trash, shopping carts, concrete debris, remains of home appliances, and tires were dumped in the creek. Children and pets playing in and around creek.
Watson Up	Trash, shopping carts, and tires were disposed of in the creek. Glass bottles were abundant. Children and pets playing in and around creek.
Stonegate	Children were often present. A small picnic area is adjacent to the creek. SCVWD removed logs from the creek but not garbage.
Singleton	Evidence (*e.g.*, chicken liver containers, line, hooks, bobbers, trash) of fishing and crayfish trapping was abundant. Human feces and toilet paper were abundant. A park ranger indicated numerous activities by children in the area.
Hellyer	This is a recreational area with picnic tables and a bike trail just above the creek. There was a lot of road construction just above the site mid-summer.
Bernal	Horse and human feces observed at times. Walking and bike path is adjacent to creek.
Metcalf	This is a recreational area with a bike trail just above the creek. Numerous bike riders were observed.
TPS	Samples were not affected by outside human activities

LITERATURE CITED

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Chapter II. Methods and Materials

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CHAPTER II. METHODS AND MATERIALS

In this chapter, changes to the methods and materials used in 2000 to complete the tasks related to water quality analysis are summarized. Details of the monitoring protocol are provided in the 2000 Dry Weather Monitoring Program (CSJ, 2000) document prepared by the City of San Jose Environmental Services Department and Tetra Tech, Inc. The latter document incorporates the monitoring protocol and quality assurance/ quality control (QA/QC) program submitted to the City of San Jose by Dr. Rhea L. Williamson under separate cover and as part of the contract.

DATA USAGE

The data collected in this study are part of a baseline database generated for use in the assessment of impacts of the addition of recycled water on algae growth in Coyote Creek. Potential effects of existing and post-augmentation water quality on pH, nutrient concentrations, dissolved oxygen concentrations, algae growth, and un-ionized ammonia are identified and described in Williamson and Hopkins (2001) and in Chapter III of this document.

MONITORING PLAN NETWORK DESIGN AND RATIONALE

In this section, sampling site locations and transect selection rationale are described.

Sampling Site Locations

Monitoring sites already identified by the City of San Jose were evaluated for inclusion in the SJSU monitoring plan. In addition, a field reconnaissance of Coyote Creek was conducted to identify other sites that should be monitored and sampled by the City of San Jose and/or by SJSU.

Sampling site locations were identified based on the following criteria:

- Inclusion in current river sampling programs
- Availability of historic data pertinent to the site
- Proximity to roads
- Accessibility
- Degree of public use
- Location relative to storm drains

Data summarized in this report were collected from the monitoring sites listed below. Sites marked with an asterisk (*) are those that were added to the monitoring plan for the 2001 sampling period. Note that river miles are estimates only.

- Recycled Water Transfer Pump Station (TPS). Water was collected from a continuously flowing outlet (plastic tube) in 2000 and 2001.
- *Metcalf Road Site. River Mile 22.3. Located above the percolation and fish ponds near the power station. This is a potential site for augmentation with recycled water.
- *Bernal Road Site. River Mile 20.5. Located below the Bernal Road bridge overpass east of Hwy 101.
- Hellyer Site. River Mile 16.0. Located in Santa Clara County Hellyer Park.
- Singleton Site. River Mile 15.1. Located below the landfill and upstream of a potential site for augmentation with recycled water.
- Stonegate Site. River Mile 14.2. Located in Stonegate Park.
- Watson Upstream Site. River Mile 9.3. Located on Coyote Creek above the confluence with San Miguelita Creek.
- San Miguelita Site. Located on San Miguelita Creek above the confluence with Coyote Creek. Located down gradient of the Kellogg Plant.

- Watson Downstream Site. River Mile 9.1. Located on Coyote Creek below the confluence with San Miguelita Creek and above the confluence with Penitencia Creek.

- Penitencia Creek Site. River Mile 8.5. Located off King Road near Cambridge Drive on the east side of the crossing bridge. This area is managed by the Santa Clara Valley Water District.

- Muni Golf Site. River Mile 8.0. Located on Coyote Creek below the confluence with Penitencia Creek.

Transect Selection

Permanent transects were established at all sites. The transects were located to characterize the reach, to assure that sampling occurs at the same location over time, and to allow for the assessment of algae growth from the same location. A nylon measuring tape strung across the permanent transect was used to determine stream width. Work was conducted downstream of the transect line to avoid contamination of samples by resuspended detritus and to reduce turbidity.

MONITORING PLAN PARAMETERS AND FREQUENCY OF COLLECTION

Parameters monitored focused on those identified by the City of San Jose, on those likely to be typical of recycled water, and on those currently required as part of the discharge criteria for the City. Parameters were measured either by City of San Jose personnel (CSJ) or by SJSU faculty and students (SJSU), as indicated below. In 2001, samples for the analysis of chlorophyll *a* and phaeophytin *a* were collected by SJSU; all other water samples were collected by the CSJ personnel. In addition, in 2001 all field measurements, with the exception of flow, were made by CSJ personnel.

Parameters monitored in 2001 that are assessed in this report include the following:

- Nitrogen forms (nitrate-N, nitrite-N, ammonia-N, Total Kjeldahl Nitrogen (TKN)) (CSJ)

- Phosphorus forms (total, total reactive, and soluble reactive phosphorus) (CSJ)

- Flow (SJSU)
- Substrate Type (SJSU)
- Water Temperature (CSJ)
- Dissolved Oxygen (CSJ)
- pH (CSJ)
- Accumulation of detritus (organic matter) (SJSU)
- Benthic and planktonic chlorophyll a and phaeophytin a (SJSU)
- Conductivity (CSJ)
- Canopy Cover (SJSU)
- Total Dissolved Solids and Turbidity (CSJ)

Information related to the sample matrix type, analytical methods used, volume collected, container type, preservation method, and sample holding times for parameters collected in 2001 by the City of San Jose are summarized in Appendix II-1. Table II-1 contains information related to the analysis of samples collected by SJSU.

SAMPLING PROCEDURES

Samples for biological, chemical and physical analyses were collected from each of the sampling sites by field personnel following procedures described in Williamson and Hopkins (2001) and in the appendices of CSJ (2000). These documents include details related to sampling preparation, sample transport, laboratory analysis, recordkeeping, calibration procedures, equipment maintenance, and actions taken in the field and laboratory when data are not within an acceptable tolerance range.

Table II-1. Details Specific to the Analysis of Parameters Collected and Analyzed by SJSU in 2001 from Coyote Creek

Sample Matrix	**Analysis**	**Holding Time**	**Container**	**Preservation**	**Analytical Method**
algae pigment	chlorophyll and phaeophytin	after filtration, 6 months	plastic	Cool, filter, freeze	SM 10200-H
stream substrate	type* distribution(%)* organic matter*	n/a n/a n/a	n/a n/a n/a	n/a n/a n/a	visual visual visual
canopy	percent canopy cover*	n/a	n/a	n/a	densiometer
water	flow*	n/a	n/a	n/a	pygmy meter
water	temperature*	n/a	n/a	n/a	thermometer

*Measured in-situ and/or in the field.

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Williamson, R.L. 2000. QAQC Monitoring Plan for Coyote Creek, California. Submitted to the City of San Jose.

Williamson, R.L. and J. Hopkins. 2001. The Impact of Recycled Water on Water Quality in Coyote Creek in San Jose, California. Prepared for the City of San Jose, California.

Appendix II-1. Streamflow Project - 2001 Parameters and Methods List for the CSJ

Appendix II-1. Streamflow Project – 2001 Parameters and Methods List for the CSJ

Field Measurements:

	General Water Quality								
	Parameter	Method	Method Detection Limit (MDL)	Reporting Limit or Minimum Level (ML)	Units	Holding Time	In-House or Contract Lab	Stations Sampled	Events Sampled
1	Dissolved Oxygen	YSI/Sonde	N/A	0.1	mg/L	In situ measurement	Field Crew	All	All
2	pH	Accumet/ Sonde	N/A	0.1	pH units	In situ measurement	Field Crew	All	All
3	Specific Conductance/Practical Salinity	YSI/Sonde	N/A	5	μmho/cm	In situ measurement	Field Crew	All	All
4	Temperature	Accumet/ Sonde/ Autolog	N/A	0.1	°C	In situ measurement	Field Crew	All	All
5	Turbidity	Sonde	N/A	0.1	NTU	In situ measurement	Field Crew	All	All

Lab analysis of grab sample:									
	General Water Quality								
	Parameter	Method	Method Detection Limit (MDL)	Reporting Limit or Minimum Level (ML)	Units	Holding Time	In-House or Contract Lab	Stations Sampled	Events Sampled
1	BOD	SM5210B	NA	2	mg/L	48 hours	In-House	All	All
2	TOC – Low	SM5310B	0.25	1	mg/L	7 days	In-House	All	All
3	DOC – Low	SM5310B	0.25	1	mg/L	7 days	In-House	All	All
4	TSS	SM2540D	0.35	2	mg/L	7 days	In-House	All	All
5	TDS	SM2540C	10.3	50	mg/L	7 days	In-House	All	All
6	Total Solids	SM2540B						3*	2
7	Turbidity	SM2130B	0.03	0.1	NTU	Immediate	In-House	All	All
8	Alkalinity	SM2320B	0.35	1	mg/L CaCO3	14 days	In-House	All	All

	Nutrients & Cations								
	Parameter	Method	Method Detection Limit (MDL)	Reporting Limit or Minimum Level (ML)	Units	Holding Time	In-House or Contract Lab	Stations Sampled	Events Sampled
1	Total Ammonia (Probe)	SM4500NH 3-F	0.01	0.1	mg/L NH3-N	28 days	In-House	All	All
2	Nitrate	EPA 300	0.06	0.1	mg/L NO3-N	48 hours	In-House	All	All
3	Nitrite	EPA 354.1	0.001	0.05	mg/L NO2-N	Immediate	In-House	All	All
4	Total Kjeldahl Nitrogen	SM4500-N-org	0.1	0.5	mg/L	Immediate	In-House	All	All
5	Ortho-phosphate (total reactive phosphorus) - Low Level	EPA 365.3		0.01	mg/L as P	48 hours	Contract Lab	All	All
6	Dissolved Ortho-phosphate (soluble reactive phosphorus) - Low Level	EPA 365.3		0.01	mg/L as P	48 hours	Contract Lab	All	All
7	Total Phosphorus - Low Level	EPA 365.3		0.01	mg/L as P	28 days	Contract Lab	All	All
8	Calcium	EPA 200.7		0.1	mg/L	6 months	In-House	All	All
9	Magnesium	EPA 200.7		0.15	mg/L	6 months	In-House	All	All

	Metals, Cyanide, & Tributyltin								
	Parameter	Method	Method Detection Limit (MDL)	Reporting Limit or Minimum Level (ML)	Units	Holding Time	In-House or Contract Lab	Stations Sampled	Events Sampled
1	Standard Priority Metals	Various	See Appendix 1A		µg/L	6 months	In-House	3*	2
2	Mercury	EPA 1631	0.0005	0.002	µg/L	28 days	In-House	All	All
3	Total Chromium	EPA 218.2		0.5	µg/L	60 days	In-House	3*	2
4	Cyanide (total)	SM4500-CN-E	0.7	5	µg/L	14 days	In-House	3*	All
5	Tributyltin	Batelle N-0959-2606		0.002	µg/L	60 days	Contract Lab	3*	2
	Microbiology/Pathogens								
1	Enterococcus	EPA 1600	1 colony per 100 mL	< 1 colony per 100 mL	Colonies/ 100mL	6 hrs. @ 4°C	In-House	All	All
2	Fecal Coliforms	SM9222D	1 colony per 100 mL	< 1 colony per 100 mL	Colonies/ 100mL	6 hrs. @ 4°C	In-House	All	All
3	Total coliforms	SM9222B	1 colony per 100 mL	< 1 colony per 100 mL	Colonies/ 100mL	6 hrs. @ 4°C	In-House	All	All
4	Cryptosporidium	EPA 1623	1 oocyst/ 10L	0.1 oocyst/ L	Oocysts/L	72 hrs.	Contract Lab	3^	All
5	Giardia	EPA 1623	1 oocyst/ 10L	0.1 oocyst/ L	Cysts/L	72 hrs.	Contract Lab	3^	All

	Organic Compounds								
	Parameter	Method	Method Detection Limit (MDL)	Reporting Limit or Minimum Level (ML)	Units	Holding Time	In-House or Contract Lab	Stations Sampled	Events Sampled
1	Volatiles (603 & 624)	603 & 624	See Appendix 1B of CSJ's QA/QC		μg/L	14 days	In-House	3*	All, Min. of 2
2	Semi-volatiles	625	See Appendix 1C of CSJ's QA/QC		μg/L	7 days	In-House	3*	All, Min. of 2
3	PAH (610)	610	See Appendix 1D of CSJ's QA/QC		μg/L	7 days	Contract Lab	3*	All, Min. of 2
4	Pesticides (608)	608	See Appendix 1E of CSJ's QA/QC		μg/L	7 days	Contract Lab	3*	All, Min. of 2
5	Dioxin (2,3,7,8-TCDD) 17 Congeners	EPA 1613	See Appendix 1F of CSJ's QA/QC		μg/L	1 year	Contract Lab	3*	2
6	Diazinon	EPA 614		0.1	μg/L	7 days	Contract Lab	3*	2
7	Chlorpyrifos	EPA 614		0.1	μg/L	7 days	Contract Lab	3*	2
3* These three stations (TPS, Singleton and Metcalf Up) are the designated "Reasonable Potential" stations									
3^ The stations sampled for pathogens are Hellyer, Muni Golf and TPS. Duplicate samples for matrix spike analysis will be taken once per station per season.									

Chapter III. Results and Discussion

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CHAPTER III.   RESULTS AND DISCUSSION

In this chapter, data collected from the sites on Coyote Creek and its tributaries between July and November 2001 are summarized. Physical, chemical, and biological data are discussed in terms of relevance to the goals of this project, observed trends, and potential changes that may result following flow augmentation with recycled wastewater. Data are summarized in tables and/or figures when appropriate. Site locations on figures are ordered from the most upstream site (Metcalf Road) to the most downstream site (Muni Golf). Tributary sites (Penitencia and San Miguelita Creeks) are included when appropriate. Note that two sites at Metcalf and Bernal Roads were not monitored during 2000. These two sites, along with the recycled water storage reservoir (TPS), were monitored in 2001.

Discrete samples were usually collected in the morning or early afternoon at each site on a monthly basis from July to November 2001. Sampling in 2000 was conducted monthly to bimonthly during daylight hours. Comparisons of average data collected during these sampling events are made for some parameters. Raw data for 2000 are provided in tabular form in Appendix III-A. Data collected by CSJ personnel in 2001 are tabulated in Appendix III-B. Quality Assurance/Quality Control issues related to data analyzed by the CSJ are provided in Appendix III-C. Chlorophyll data determined by SJSU are provided in Appendix III-D.

PHYSICAL CHARACTERISTICS

Physical characteristics discussed in this section include canopy cover, water temperature, discharge, turbidity, and total suspended solids concentrations.

Canopy Cover

The range of canopy cover did not vary significantly at a given site from that reported in 2000 except at the Hellyer, and Penitencia Creek sites, which were relocated (Table III-1). In general, the Coyote Creek sites had higher canopy cover than the two tributary sites, with the exception of the Singleton and Stonegate sites. Canopy cover at San Miguelita Creek was non-existent.

Table III-1. Range of canopy cover for study sites on Coyote Creek, California between June and November, 2000 and July and November, 2001.

SITE LOCATION	2000 RANGE CANOPY COVER (%)	2001 RANGE CANOPY COVER (%)
Metcalf	NA	85
Bernal	NA	80-90
Hellyer*	78-93	80-93
Singleton	56-65	55-67
Stonegate	67-92	45
Watson Up*	85-95	86-95
San Miguelita Creek	1-7	0
Watson Down	70-92	60-94
Penitencia Creek*	20-40	50-64
Muni Golf	83-91	89-92

* indicates that the site was relocated in 2001.

Temperature

In 2001, the temperature of Coyote Creek measured at discrete times in the morning or afternoon hours ranged from 14.2 ^{o}C to 22.0 ^{o}C. Seasonal fluctuations in temperature were observed at all creek sites, with a noticeable decrease in October and November (Figure III-1). Recycled water sampled at the Transfer Pump Station (TPS) had temperatures that were considerably higher than the creek and tributary sites; TPS temperature always exceeded the maximum temperature of 20.0 ^{o}C for cold water fish habitat (CRWQCB-SFBR 1986). Temperatures at several of the creek sites also exceeded this maximum temperature in July. Note that data are specific to time of measurement. Figure III-2 shows the average temperature in 2001 for each creek site along with average temperatures obtained in 2000. Average water temperatures in 2001 are lower at all locations. Furthermore, average temperatures in the creek and tributary sites never exceeded the maximum temperature for cold water fish habitat.

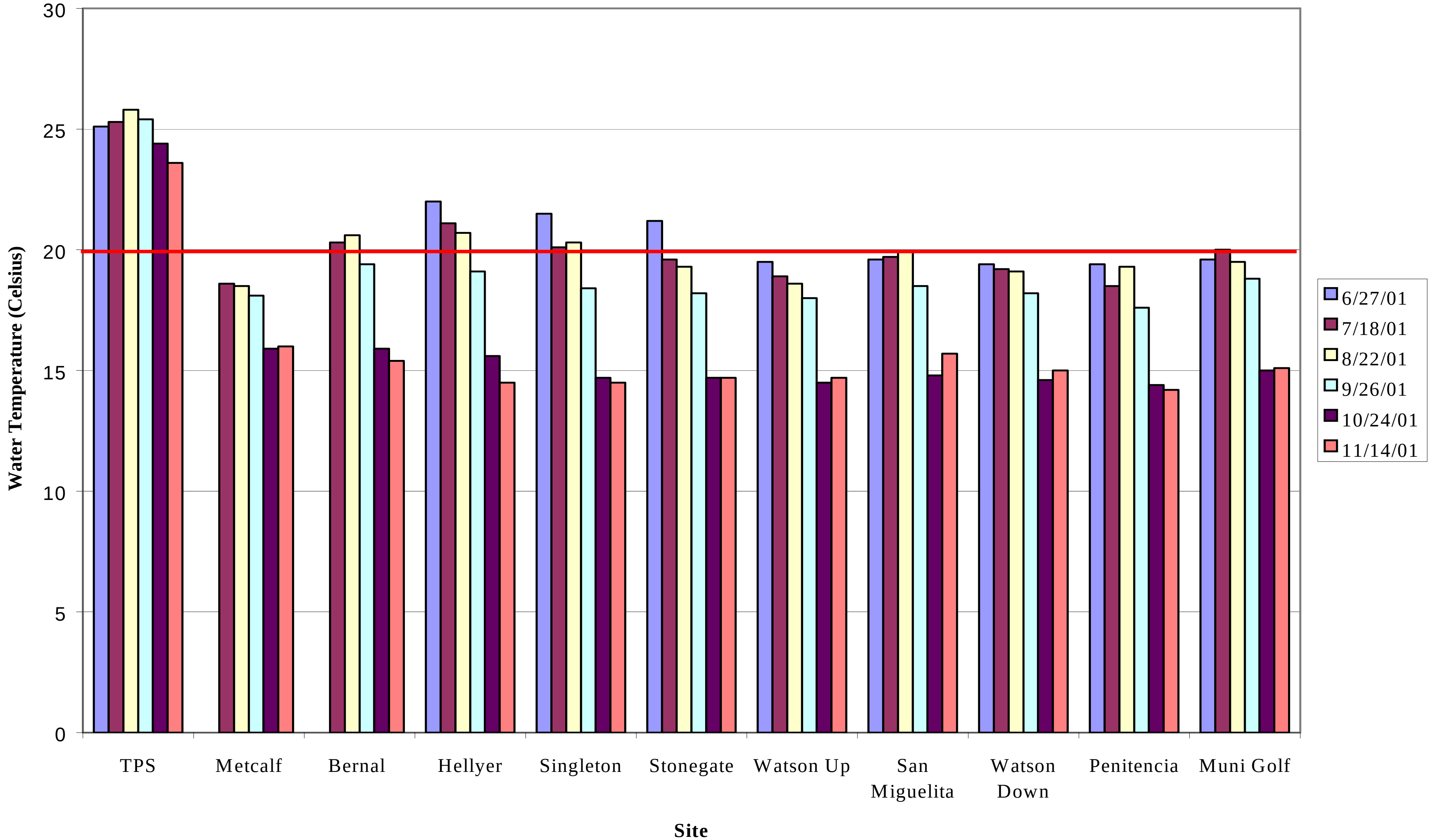

Figure III-1. Temperatures measured monthly at Coyote Creek and tributary sites between June and November 2001. Horizontal line represents the maximum temperature for cold water fish habitat (CRWQCB-SFBR, 1986).

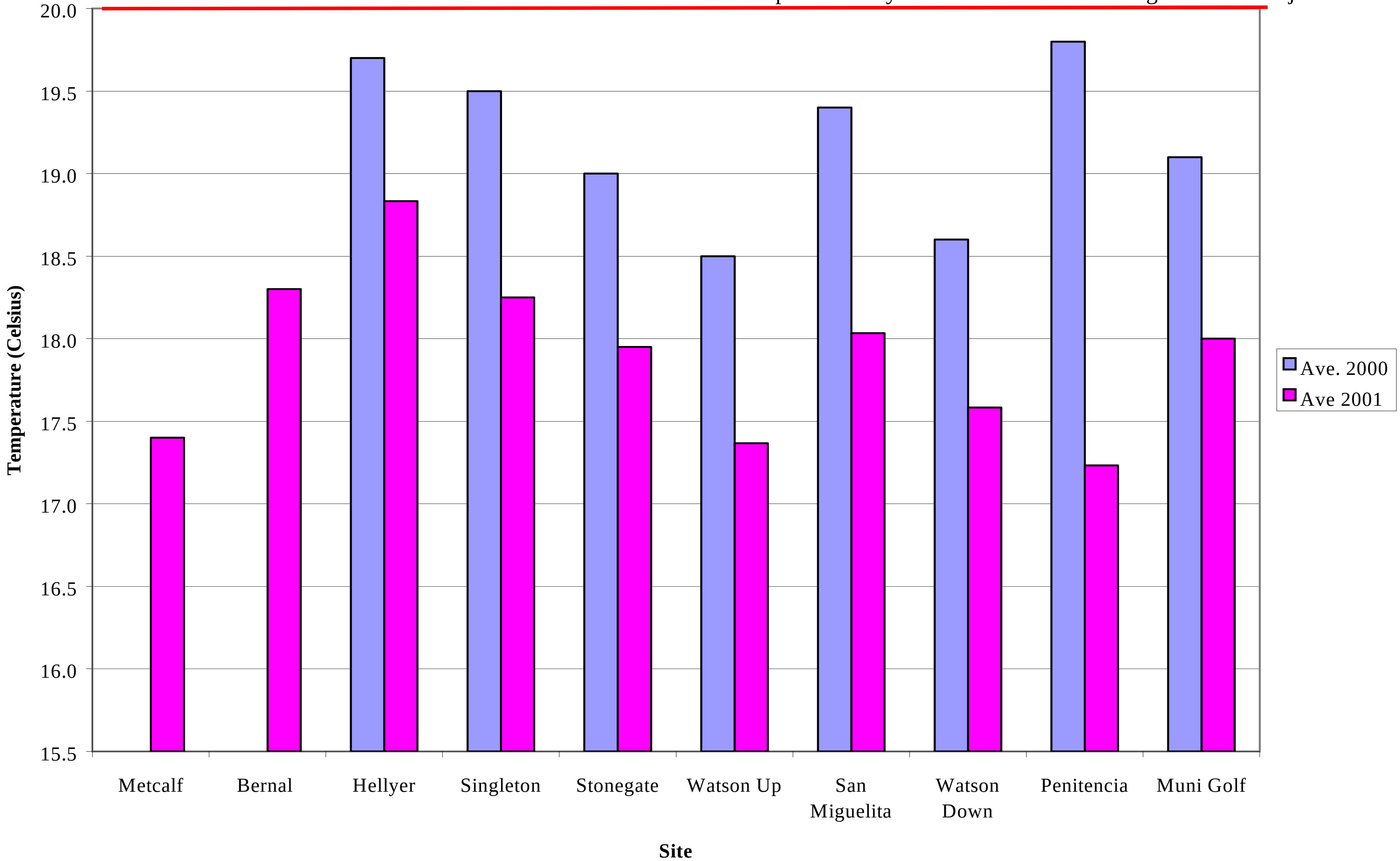

Figure III-2. Average temperatures for discrete monthly sampling at Coyote Creek and tributary sites between June – November 2000 and June - November 2001. Horizontal line represents the maximum temperature for cold water fish habitat (CRWQCB-SFBR, 1986).

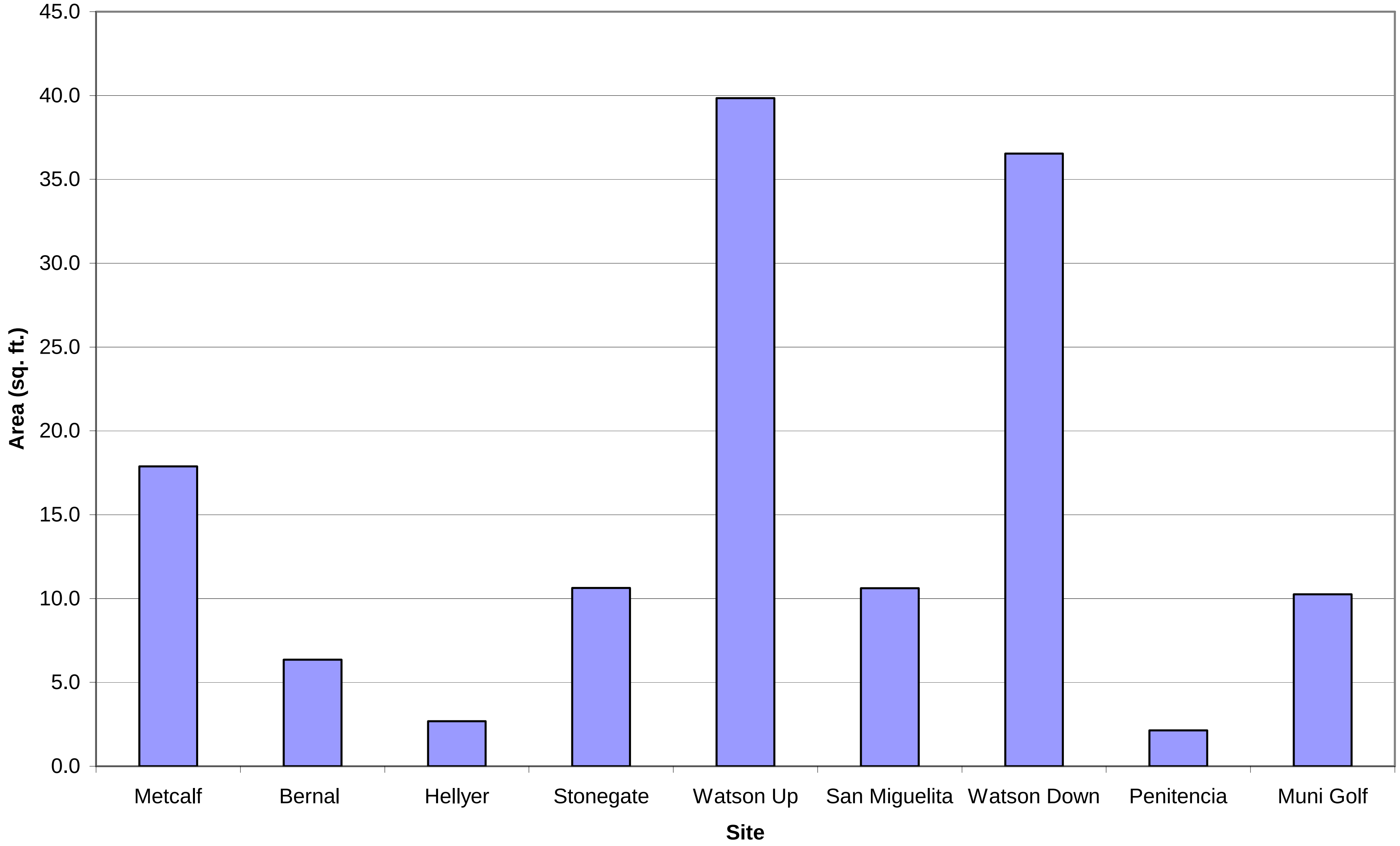

Figure III-3. Average cross-sectional areas for discrete monthly sampling at Coyote Creek and tributary sites between July and November 2001.

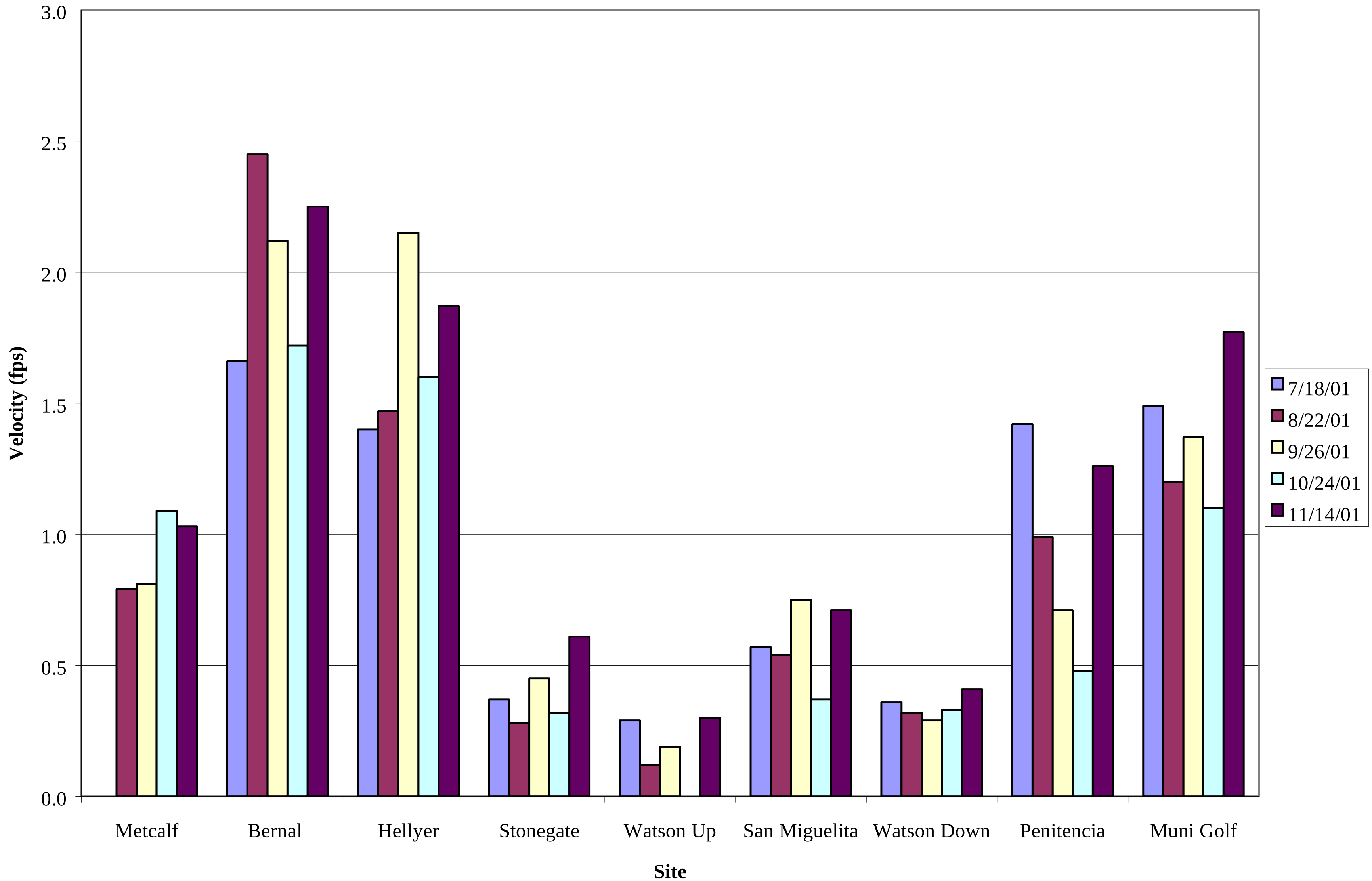

Figure III-4. Velocity measured monthly at all Coyote Creek and tributary sites between July and November 2001.

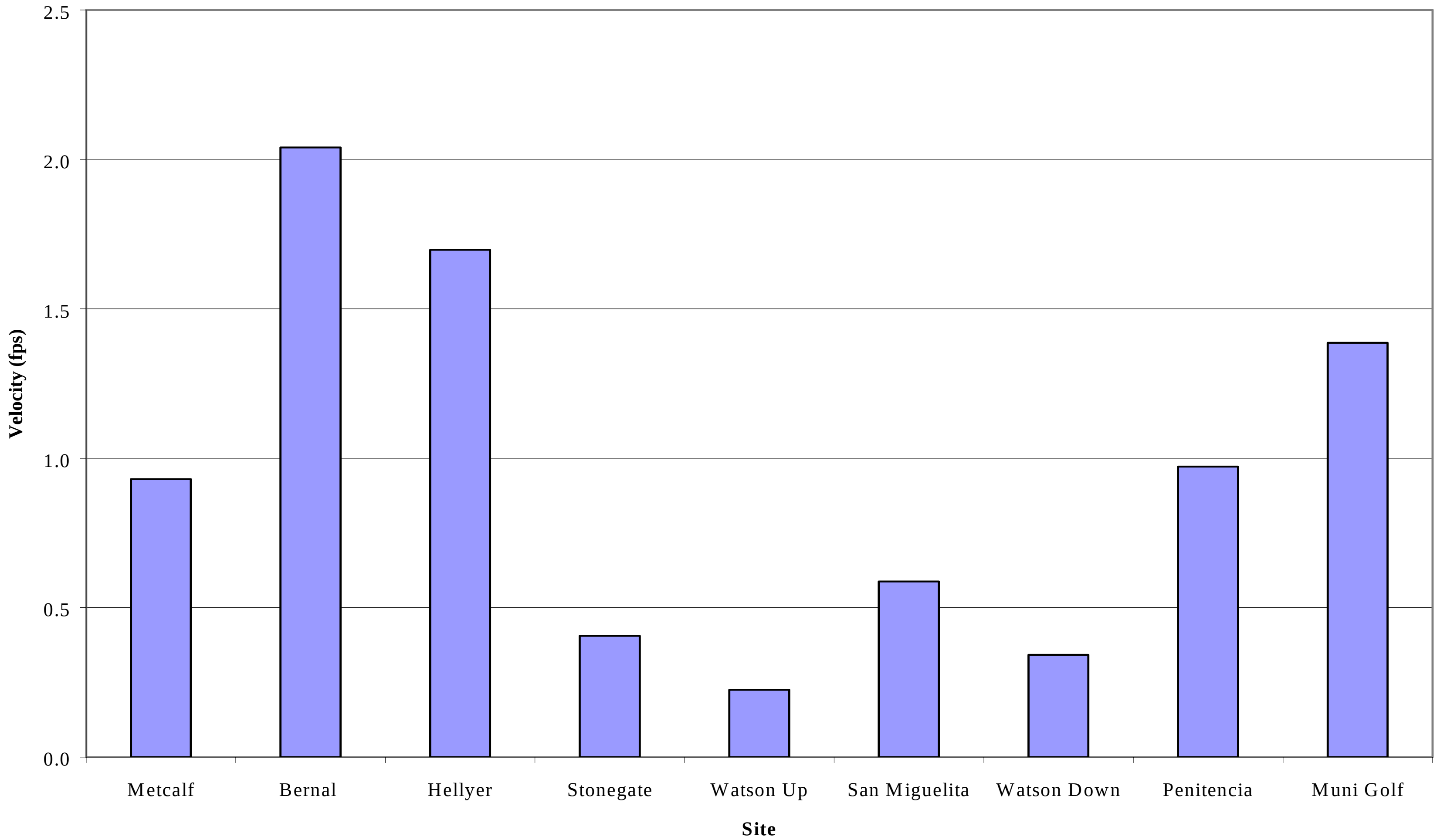

Figure III-5. Average velocity for discrete monthly sampling at Coyote Creek and tributary sites between July and November 2001.

Discharge

Figure III-6 shows the discharge at each site during each sampling event. Discharge was obtained using measurements of width and depth to obtain cross-sectional area and velocity measurements at each site. When the velocity at a site was lower than the lower limit on the flow meter, the velocity was assumed to be the lowest measurable value of 0.07 feet per second (fps). Cross-sectional and velocity measurements were not measurable at Singleton; therefore, discharge was not calculated for that site.

Although values vary at each site between sampling events, there was a general trend of increased discharge over time. Discharge variability was confounded by difficulties in measuring flow velocity, by the existence of numerous storm drains and other non-point sources along the creek, and by releases from the reservoir. Figure III-7 presents the average discharge at each site. The addition of the Metcalf and Bernal sites changed the conclusions of 2001, that the up-gradient sites had less discharge than the down gradient sites. The data indicate that discharge was significantly reduced between the Bernal and Hellyer sites; recharge to the underlying groundwater basin may explain this observation. Discharge in Coyote Creek was impacted by the tributaries. Data are similar to that collected in 2000.

Turbidity

Turbidity was variable in Coyote Creek and its tributaries throughout the sampling period (Figure III-8). Recycled water turbidity was always lower than turbidity measured in the creek. The lowest turbidity (0.05 NTU) was measured in recycled water (TPS) and the highest turbidity (45.4 NTU) was measured in San Miguelita Creek. In general, turbidity increased over time at most sites; this was the opposite of the trend observed in 2000. Construction and other human activities may explain the change. Figure III-9 shows the average turbidity for all the sampling sites in 2001. The average is quite similar to that measured in 2000. Turbidity is the lowest in the uppermost reaches of the Coyote Creek study area. The influence of the tributaries is evident, with San Miguelita Creek increasing and Penitencia Creek decreasing turbidity in Coyote Creek.

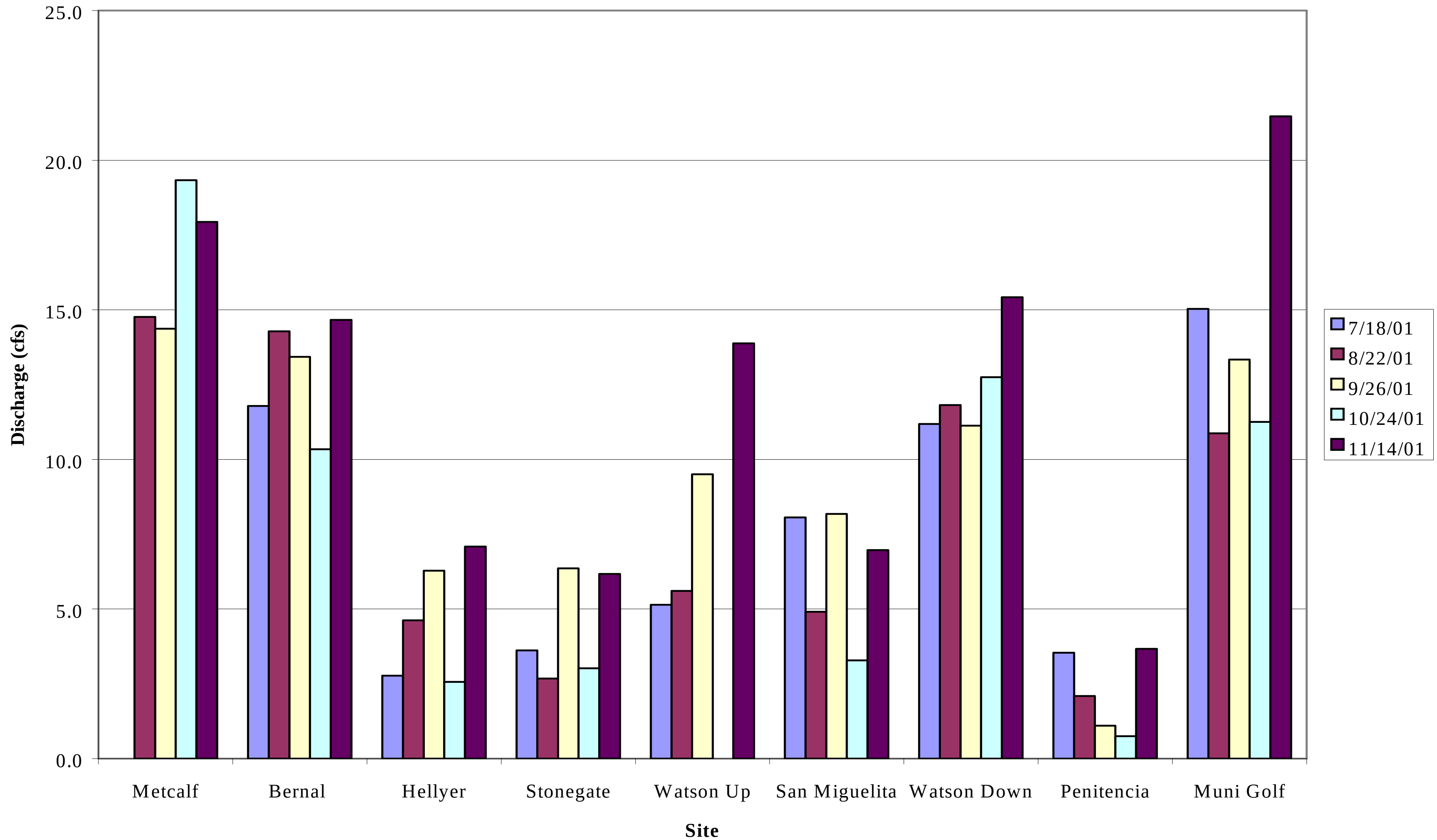

Figure III-6.   Discharge measured monthly at all Coyote Creek and tributary sites between July and November 2001.

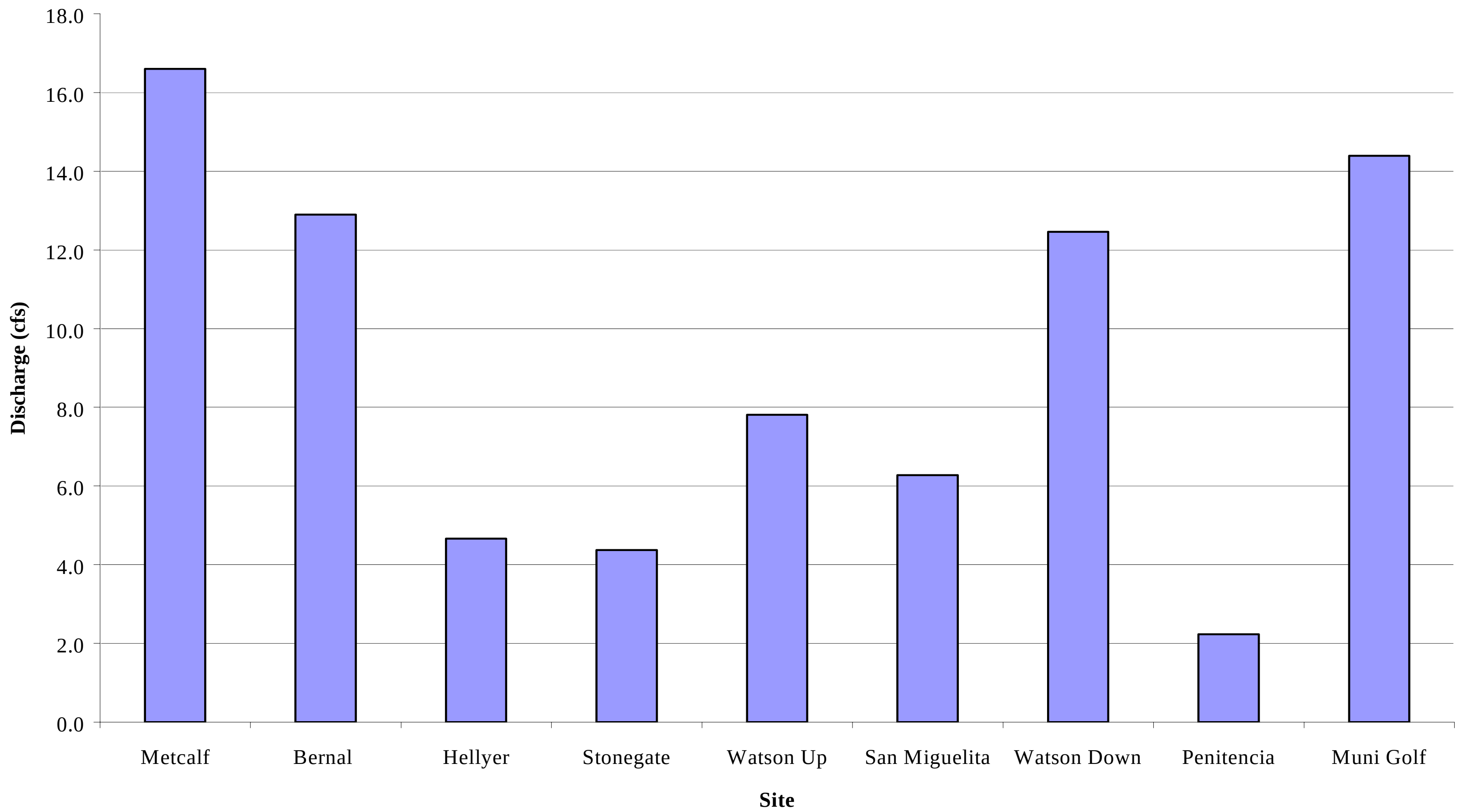

Figure III-7.   Average discharge for discrete monthly sampling at Coyote Creek and tributary sites between July and November 2001.

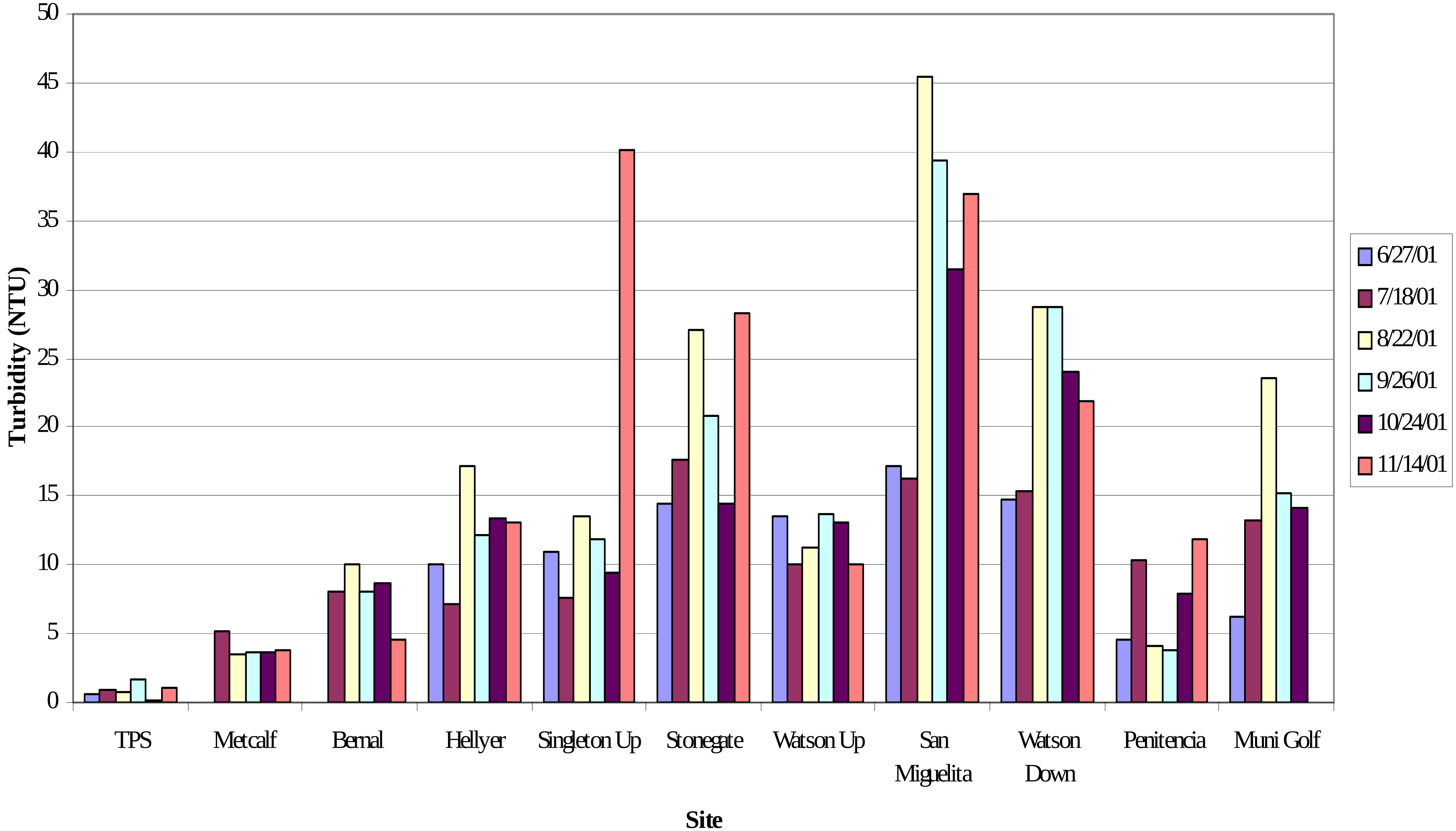

Figure III-8.   Turbidity measured monthly at all Coyote Creek and tributary sites between June and November 2001.

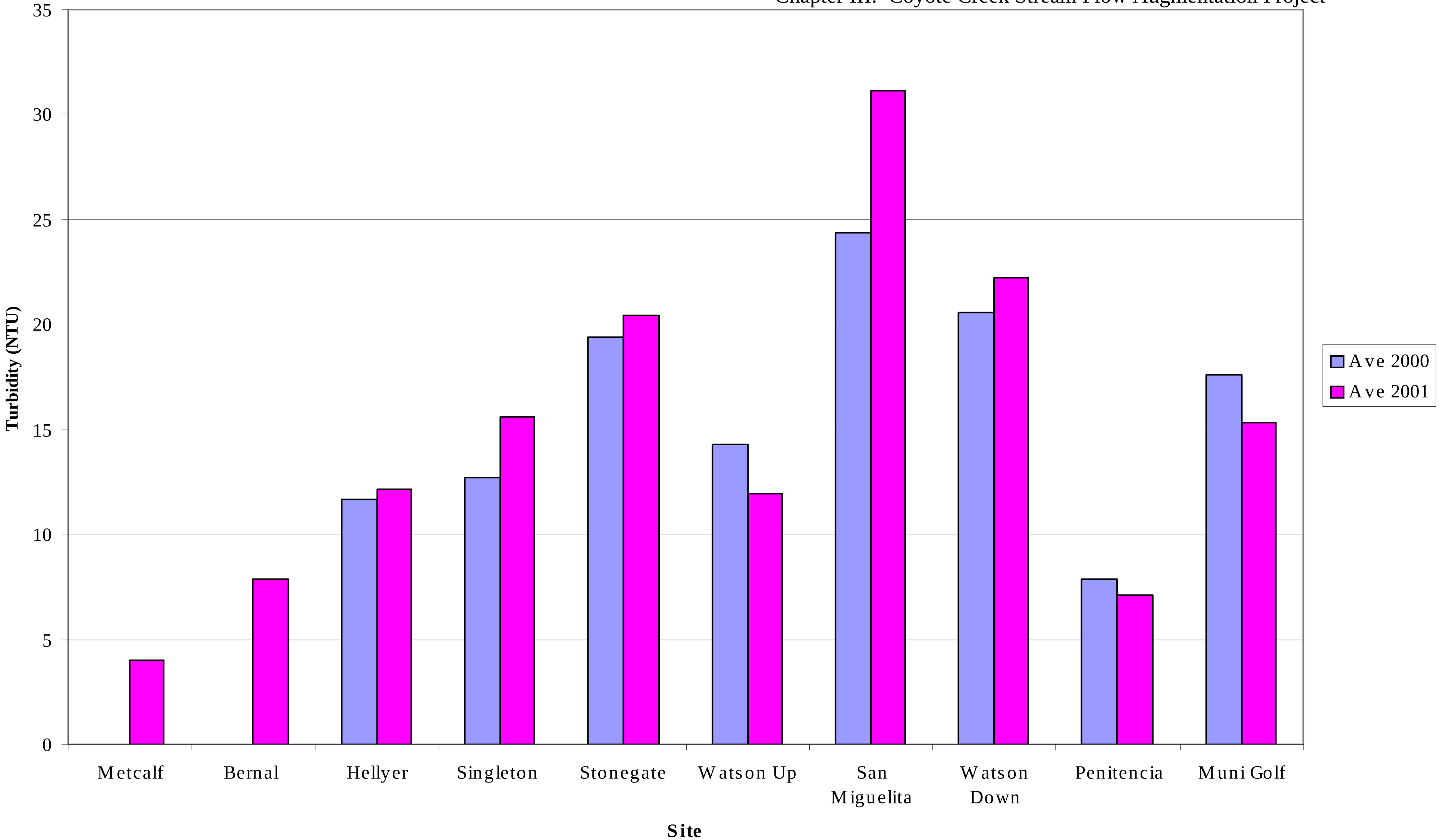

Figure III-9. Average turbidity for discrete monthly sampling at Coyote Creek and tributary sites between June and November 2000 and July and November 2001.

Total suspended solids

The total suspended solids (TSS) concentration for all sites is shown in Figure III-10. For the new sites (all those above the Hellyer site), the TSS was considerably lower than all other Coyote Creek sites. Extremely low TSS concentrations were measured in recycled water samples (TPS). The impact of San Miguelita Creek on Coyote Creek is apparent in the increase of TSS at Watson Down compared to Watson Up. Figure III-11 shows the average TSS concentrations for all the sampling sites obtained in 2000 and 2001. In general, San Miguelita Creek contributed higher TSS levels to Coyote Creek, whereas Penitencia Creek diluted Coyote Creek. Total suspended solids data (Fig. III-11) are consistent with turbidity data (Fig. III-9), as expected; TSS data for 2001 are comparable to that of 2000.

CHEMICAL CHARACTERISTICS

Chemical characteristics discussed in this section include total dissolved solids, pH, dissolved oxygen, percent oxygen saturation, Biochemical Oxygen Demand (BOD), and nutrients (total phosphorous, soluble reactive phosphorus, orthophosphate, total ammonia, total Kjeldahl nitrogen, nitrite-nitrogen , and nitrate –nitrogen) and total organic carbon.

Total dissolved solids

Figure III-12 shows the total dissolved solids (TDS) concentrations at each sampling site for each sampling event. The TDS concentrations were elevated in the recycled water samples (TPS) relative to the creek sites. The strong influence of elevated TDS concentrations at the San Miguelita Creek site is quite apparent. TDS concentrations were relatively low in the upper reaches of the creek, and nearly doubled at the Watson Down site. This increase may be associated with storm drain discharges as discussed later in this report. Average TDS concentrations measured at each site in 2001 were similar to those measured in 2000 (Figure III-13).

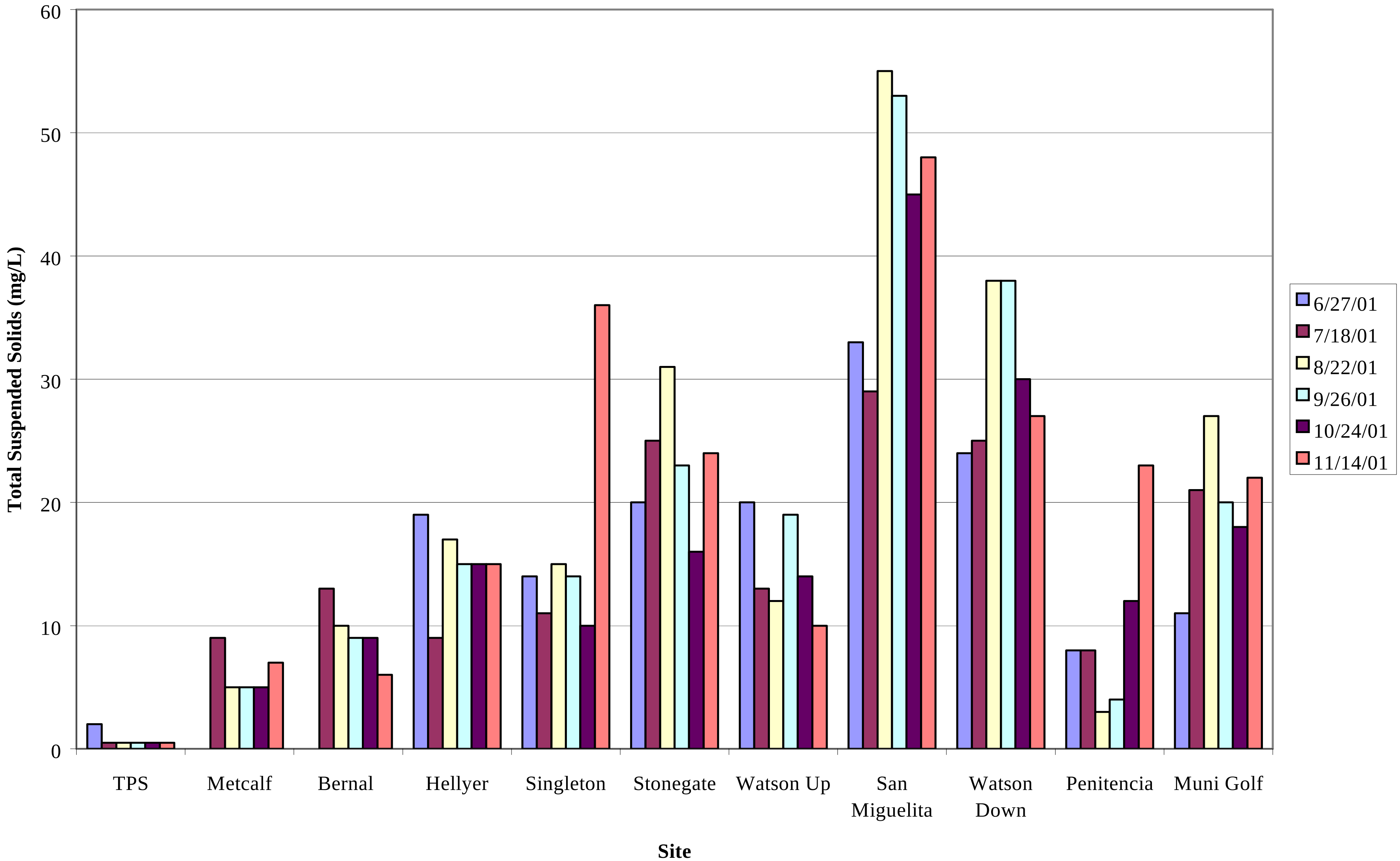

Figure III-10. Total suspended solids measured monthly at all Coyote Creek and tributary sites between June and November 2001.

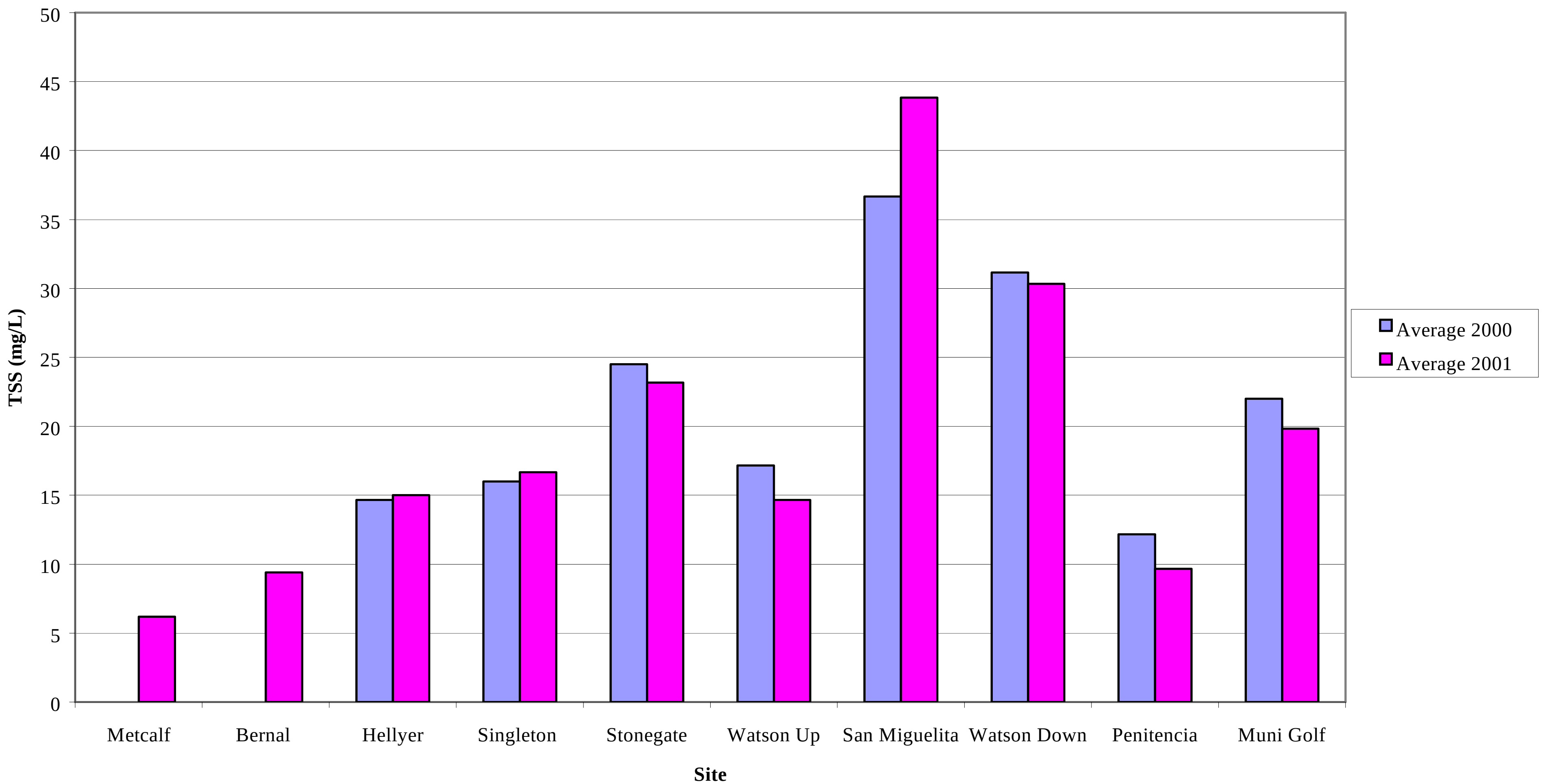

Figure III-11. Average total suspended solids for discrete monthly sampling at Coyote Creek and tributary sites between May and November 2000 and June and November 2001.

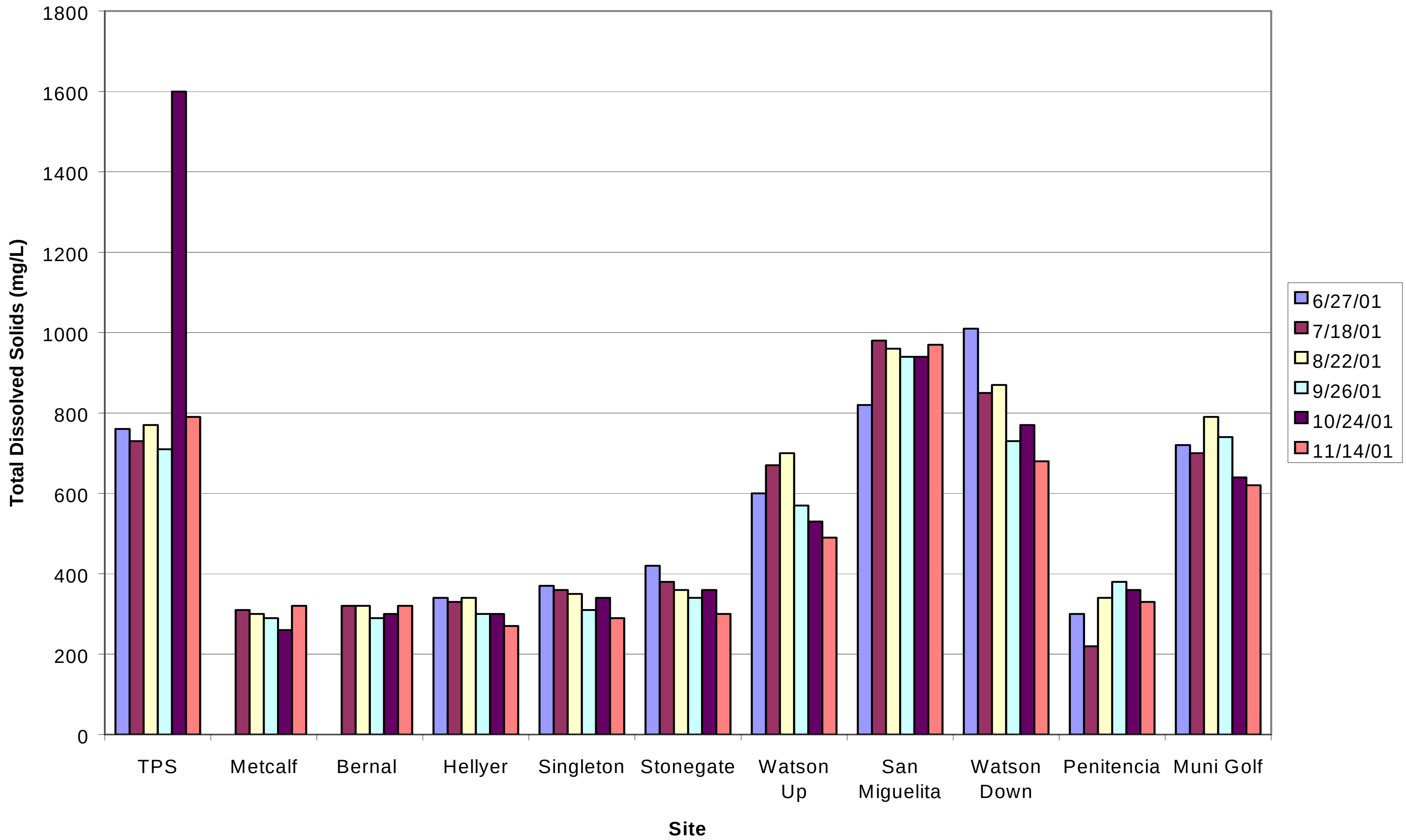

Figure III-12. Total dissolved solids measured monthly at all Coyote Creek and tributary sites between June and November 2001.

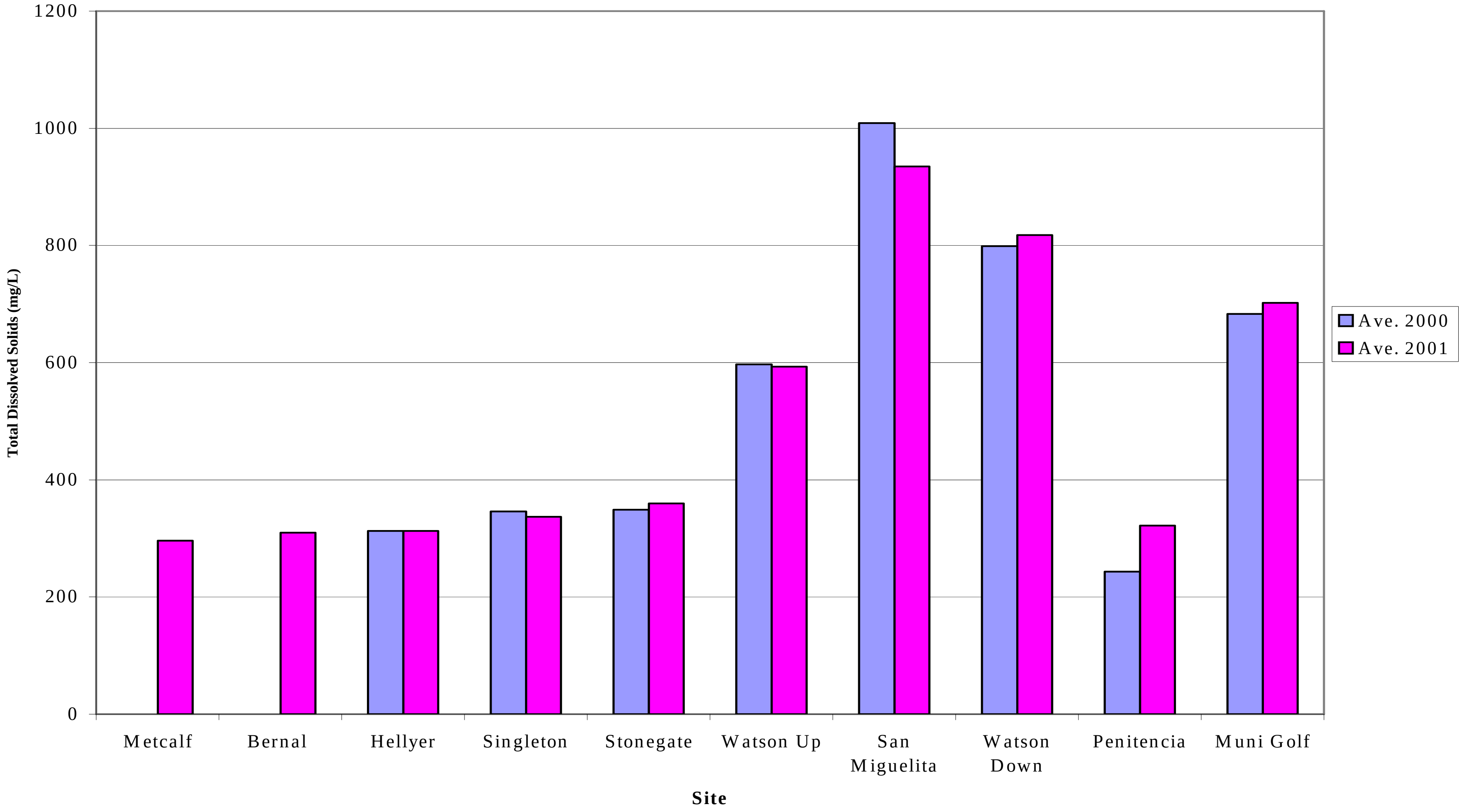

Figure III-13. Average total dissolved solids for discrete monthly sampling at Coyote Creek and tributary sites between May and November 2000 and June and November 2001.

pH

Figure III-14 highlights the range and variability of pH measured at all of the sampling sites during each sampling event. A decrease in pH occurred at all Coyote Creek sites in November. Figure III-15 presents the average pH at all sites in 2000 and 2001. Results are comparable, with slightly lower pH values measured in 2001. Tributary sites show the highest average pH. The lowest pH values were measured at Watson Up (as in 2000) where anaerobic sediments were typical. In contrast, low pH values at Metcalf Road were not associated with anaerobic sediments; upstream impacts or temporal variability may account for the pH values recorded there. Recycled water (TPS) pH was the lowest measured (Figure III-14). The pH values measured at Bernal, Hellyer, Stonegate, and Singleton were similar throughout the sampling period. pH values were less than 8.3 pH units with few exceptions, indicating a bicarbonate-based system. Exceptions were in the tributary sites, particularly at Penitencia Creek during periods of algae growth.

Dissolved Oxygen

Figure III-16 shows the dissolved oxygen (D.O.) concentration for each sampling event. In general, D.O. concentrations at the creek sites increased throughout the sampling period. Dissolved oxygen concentrations were considerably below saturation values for several sites and on several occasions. The D.O. was measured below the minimum concentration required for a cold water fish habitat (7 mg/L as oxygen; CRWQCB-SFBR, 1986) at least once for every Coyote Creek site except for the Bernal and Metcalf sites. Low D.O. was often a problem in the reach of Coyote Creek between Watson Up and Muni Golf. The lowest D.O. concentrations occurred at Watson Up, where D.O. typically measured less than 4 mg/L. Figure III-17 shows the average D.O. concentration at all of the sampling sites for 2000 and 2001. In general, average D.O. concentrations in Coyote Creek sites were lower in 2001 than in 2000. In 2000, average concentrations at several sites below Metcalf were less than 7 mg/L; at Watson Up, the average was only 2 mg/L. Average dissolved oxygen at the tributary sites was higher than the Coyote Creek sites.

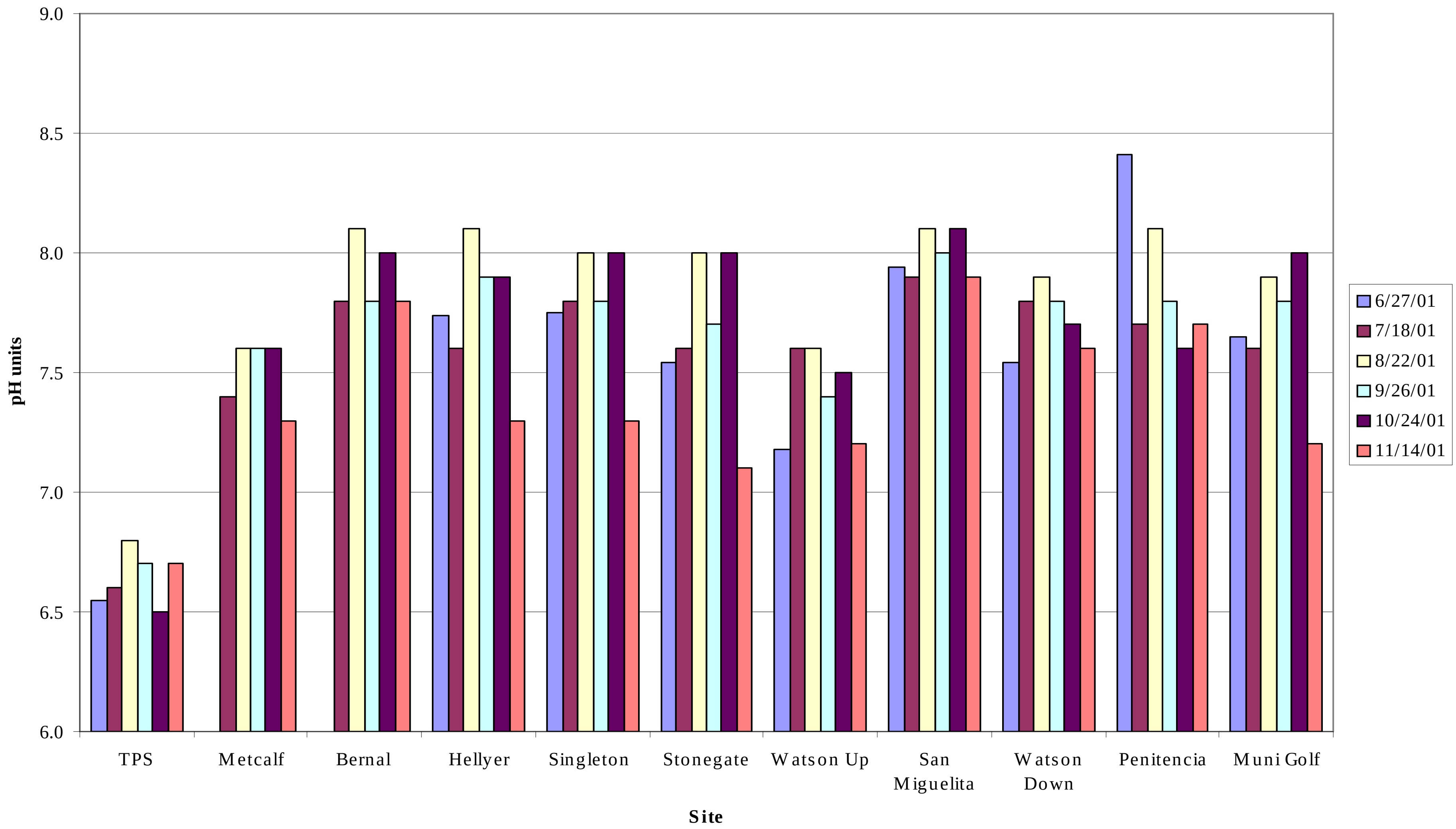

Figure III-14. pH measured monthly at all Coyote Creek and tributary sites between May and November, 2000 and June and November 2001.

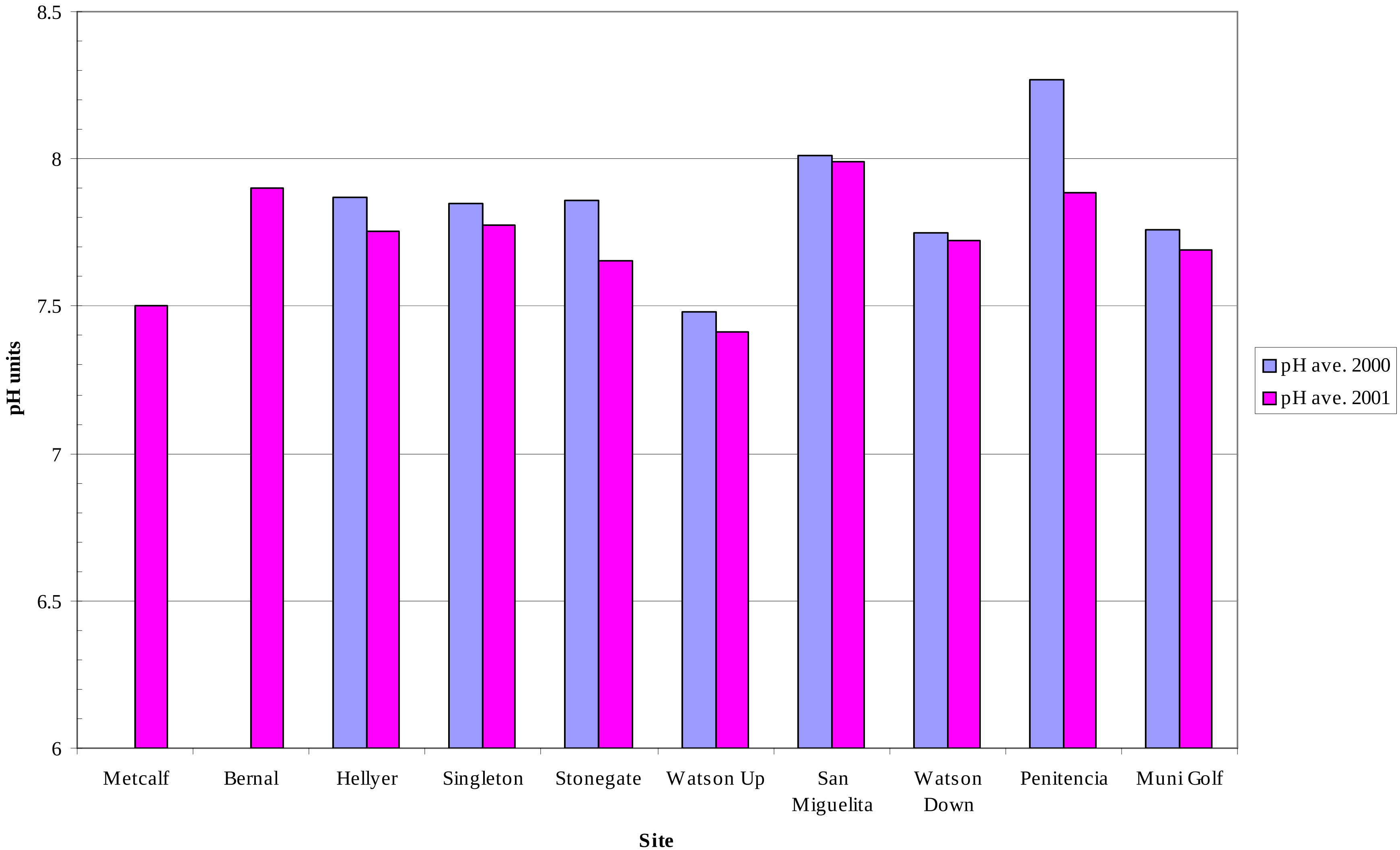

Figure III-15. Average pH for discrete monthly sampling at Coyote Creek and tributary sites between May and November, 2000 and June and November 2001.

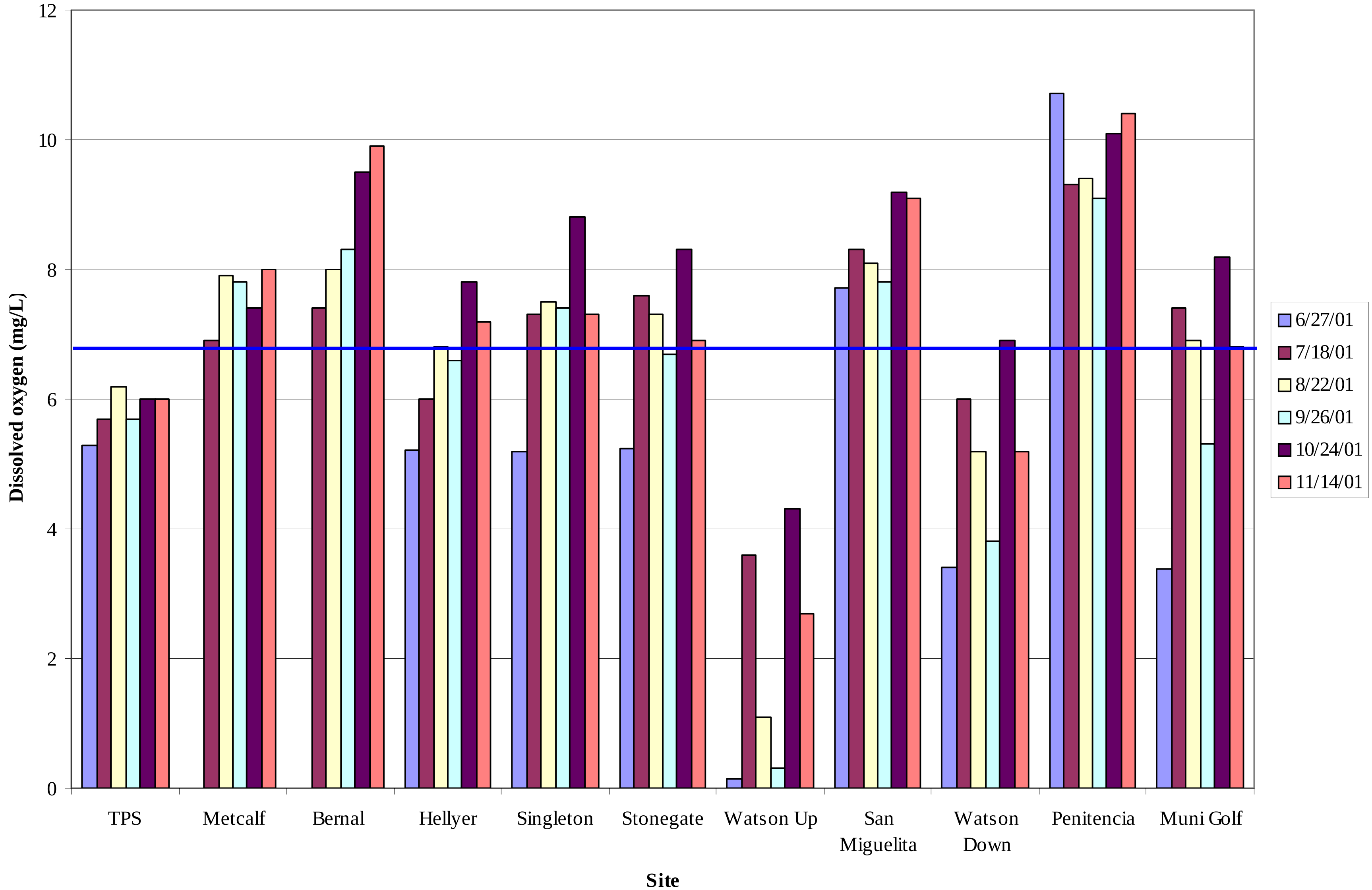

Figure III-16. Dissolved oxygen measured monthly at all Coyote Creek and tributary sites between June and November 2001. Blue line represents minimum D.O. concentration for cold water fish habitat (CRWQCB-SFBR, 1986).

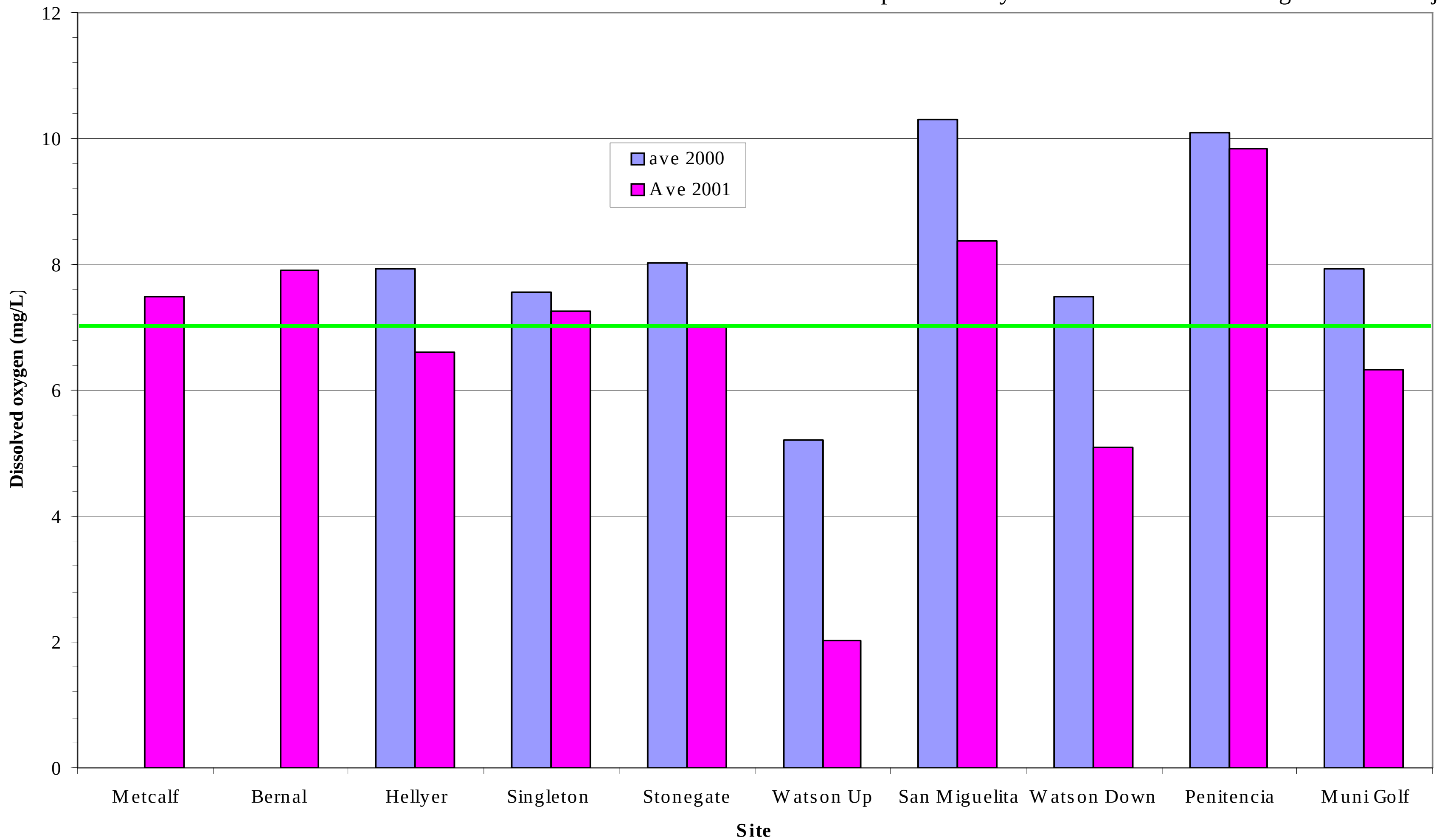

Figure III-17. Average dissolved oxygen for discrete monthly sampling at Coyote Creek and tributary sites between May and November 2000 and July and November 2001. Green line represents minimum D.O. concentration for cold water fish habitat (CRWQCB-SFBR, 1986).

Percent oxygen saturation

Figure III-18 shows the average percent oxygen saturation for discrete measurements taken at each sampling site. Percent saturation was lower in 2001 than in 2000 at most sites. As in 2000, the highest percent saturation was measured at the tributary sites (which were typically supersaturated) and the lowest percent saturation (20 percent) was measured at Watson Up. Low percent saturation continued down stream to Muni Golf. Coyote Creek sites were generally undersaturated with respect to dissolved oxygen, with 70 to 80 percent saturation typical.

Biochemical Oxygen Demand

In 2001, the City of San Jose collected water for the analysis of biochemical oxygen demand (BOD). Figure III-19 shows that at many sites, the values were typically less than the Practical Quantitation Limit (PQL) of 2.0 mg/L. When data were reported below the PQL, the midpoint between the PQL and zero was used in developing Figure III-19. Notable exceptions were at the Watson Up and Watson Down sites, where BOD concentrations as high as 26 mg/L as oxygen were recorded. This may explain the extremely low dissolved oxygen concentrations measured at these sites. The sources of the organic loading contributing to these high BOD concentrations are not known; however, multiple storm drains discharge into the creek in this area, human feces, and other sources of organic loading were common along the banks of the creek.

Total Phosphorus

In 2001, the City of San Jose collected water for the analysis of total phosphorus (TP). When data were reported below the Practical Quantitation Limit (PQL), the midpoint between the PQL and zero was used in developing figures. Figure III-20 indicates that the recycled water contains considerably higher concentrations of TP than the creek sites. Between Metcalf and Stonegate, TP is relatively low (<0.1 mg/L as P), however increased concentrations are evident beginning at Watson Up. San Miguelita Creek appears to contribute TP to the creek as well. Levels of approximately 0.2 mg/L as P continue to Muni Golf. These levels are sufficient to promote algae blooms.

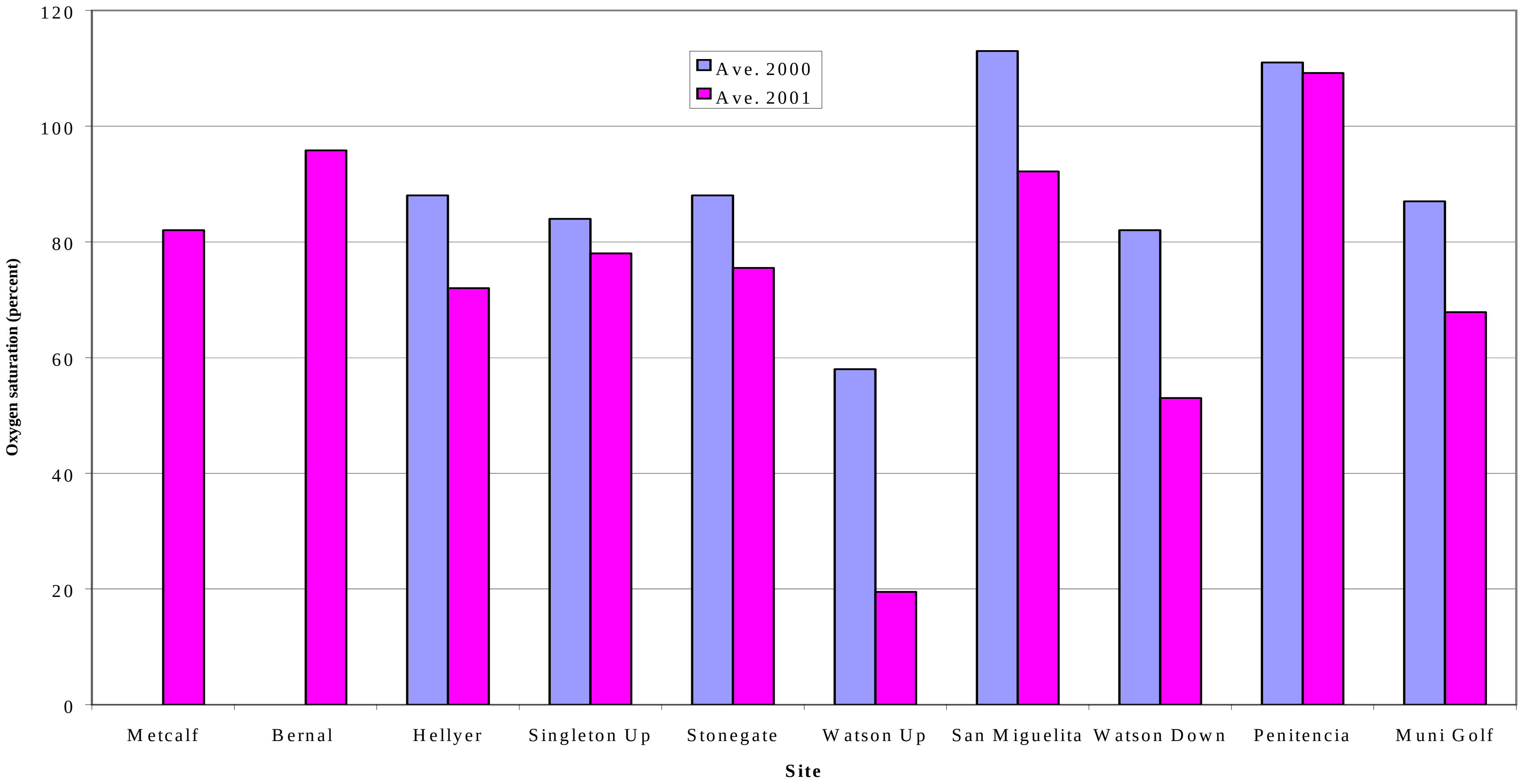

Figure III-18. Average percent saturation for discrete monthly sampling at Coyote Creek and tributary sites between May and November 2000 and June and November 2001.

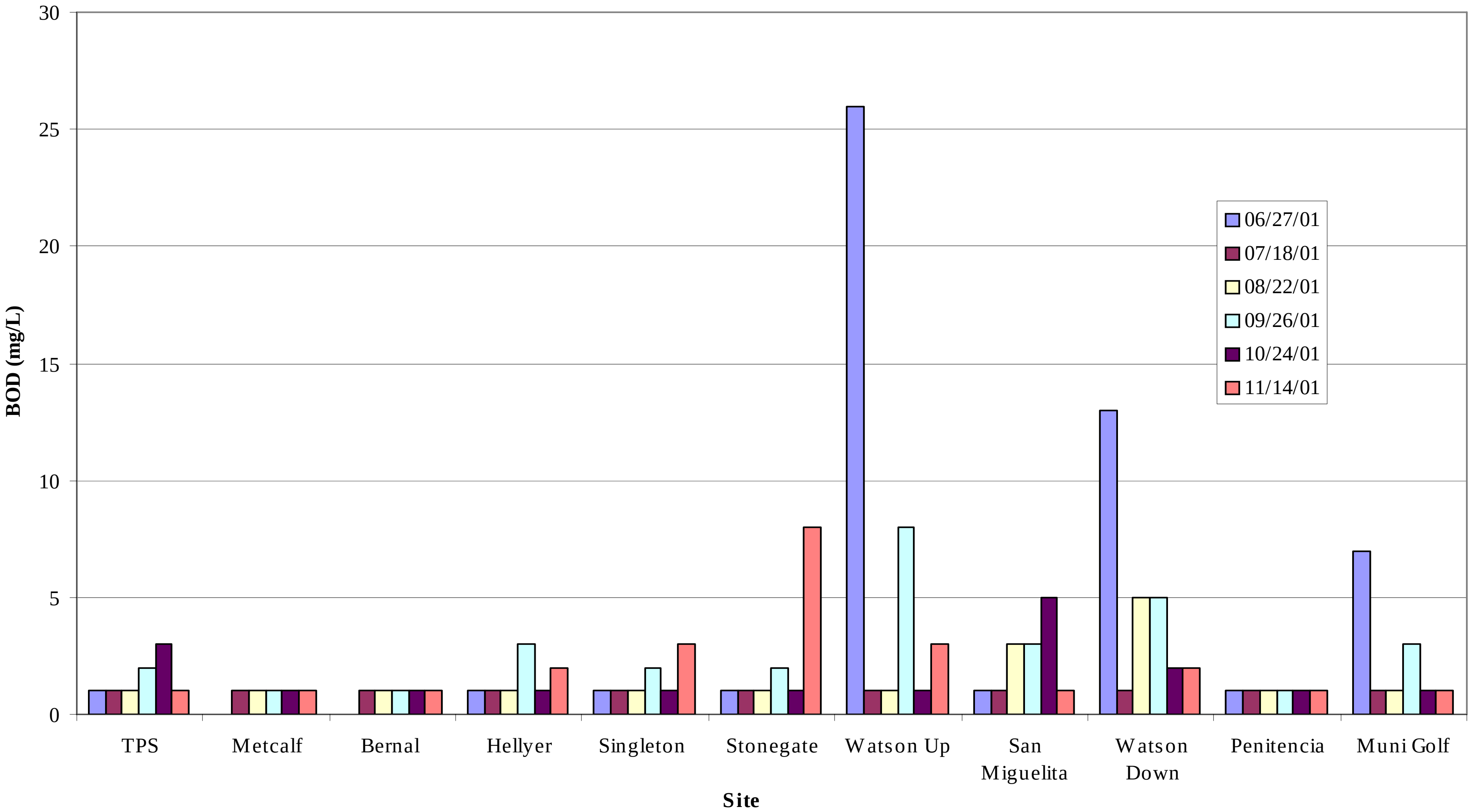

Figure III-19. Biochemical oxygen demands measured monthly at all Coyote Creek and tributary sites between June and November 2001.

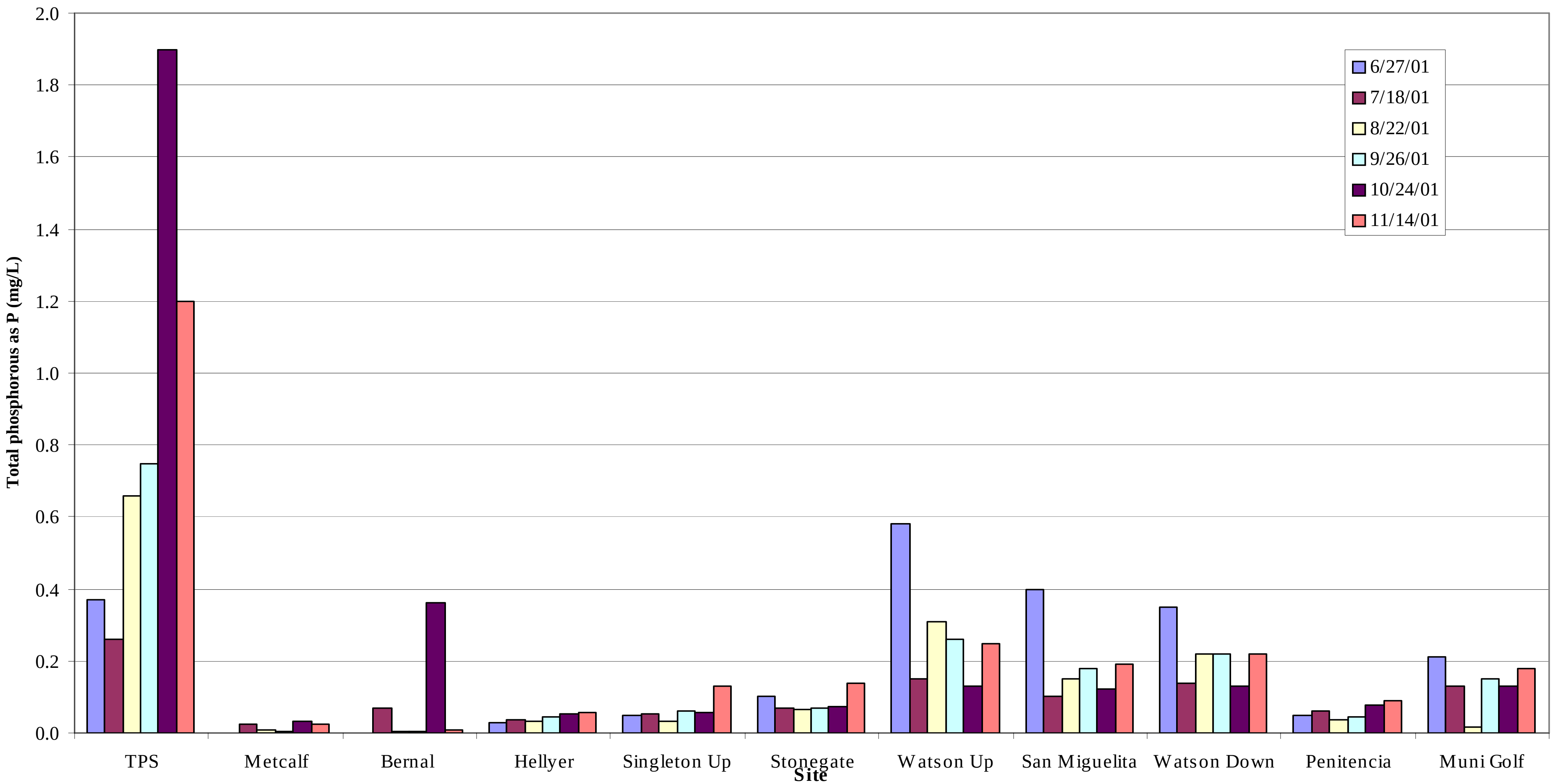

Figure III-20. Total phosphorus measured monthly at all Coyote Creek and tributary sites between June and November 2001.

Soluble Reactive Phosphorus

Figure III-21 shows soluble reactive phosphorus (SRP) concentrations at all the sampling sites during each sampling event. In general, SRP concentrations were very high in recycled water (TPS) relative to the creek water. SRP concentrations were constant over time in the creek sites. Concentrations in the most upstream sites were very low and increased downstream. Soluble reactive phosphorous concentrations were highest at Watson Up followed by San Miguelita Creek and Watson Down.

Orthophosphate

Figure III-22 shows orthophosphate concentrations at all the sampling sites during each sampling event. Orthophosphate concentrations were very high in recycled water relative to the creek water. Concentrations in the most upstream Coyote Creek sites were very low, gradually increasing with each downstream location. A relatively sharp increase occurred between the Stonegate and Watson Up sites in all months; the highest concentration was measured in June. Orthophosphate concentrations were elevated in San Miguelita Creek but were low in Penitencia Creek relative to the Coyote Creek sites.   Figure III-23 shows average orthophosphate concentrations at all sites in 2000 and 2001. In general, orthophosphate concentrations were higher in 2001 than in 2000.

Total Ammonia

Total ammonia (NH_3 + NH_4^+) values were typically less than the Practical Quantitation Limit (PQL) of 0.1 mg/L NH_3-N. When data were reported below the PQL, the midpoint between the PQL and zero was used in developing figures. The recycled water (TPS) contained elevated total ammonia in June, with a concentration of 0.3 mg-L NH_3-N reported (Figure III-24). Total ammonia concentrations were below the PQL at the Coyote Creek sites upstream of Watson Up, although that site had levels as high as 0.4 mg/L NH_3-N. Elevated total ammonia concentrations were measured at all Coyote Creek and tributary sites below Watson Up, particularly in June, July, and August of 2001. The highest ammonia concentration reported was 0.7 mg/L NH_3-N at Muni Golf in June, 2001.

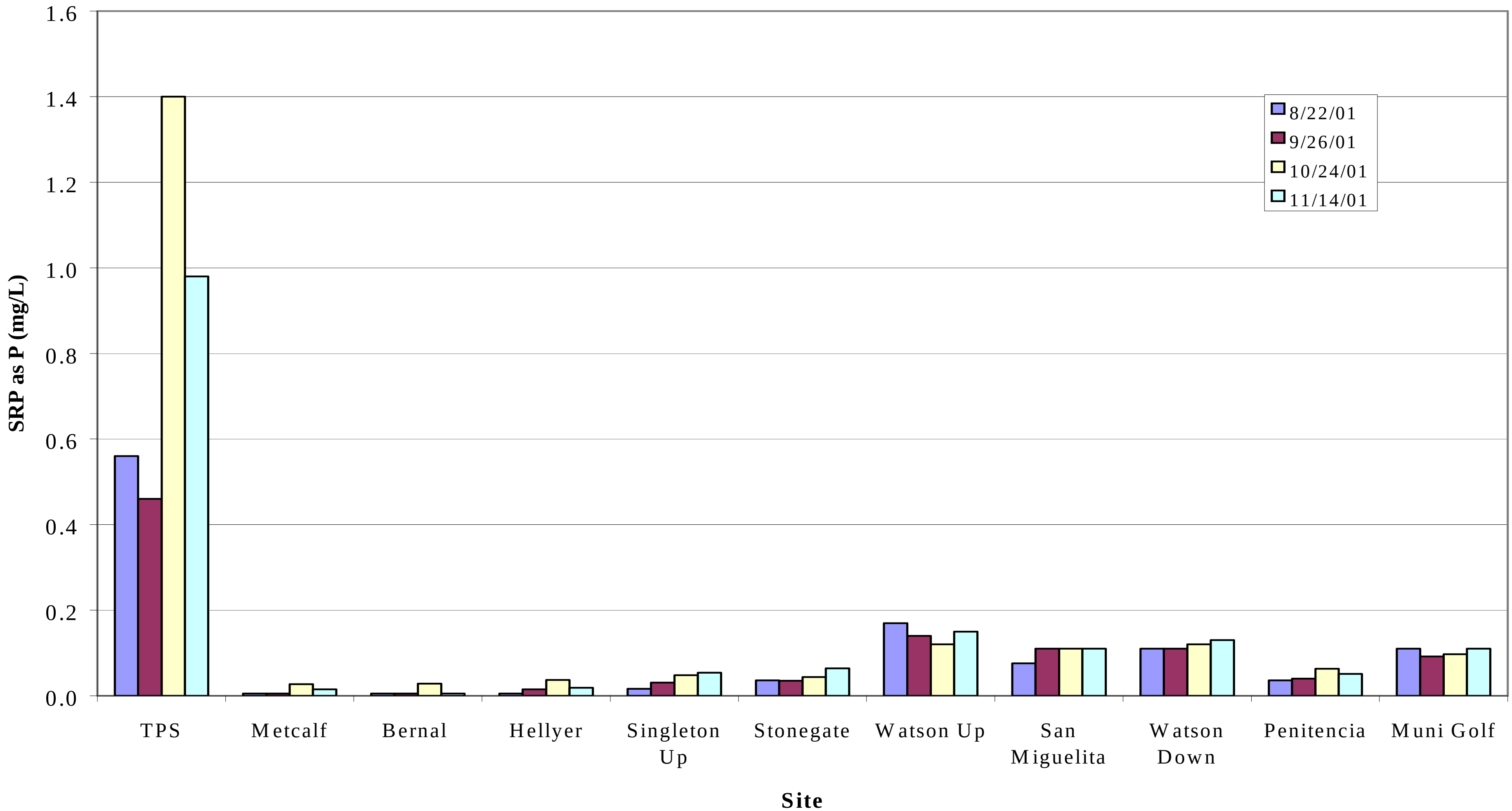

Figure III-21. Soluble reactive phosphorus measured monthly at all Coyote Creek and tributary sites between August and November 2001.

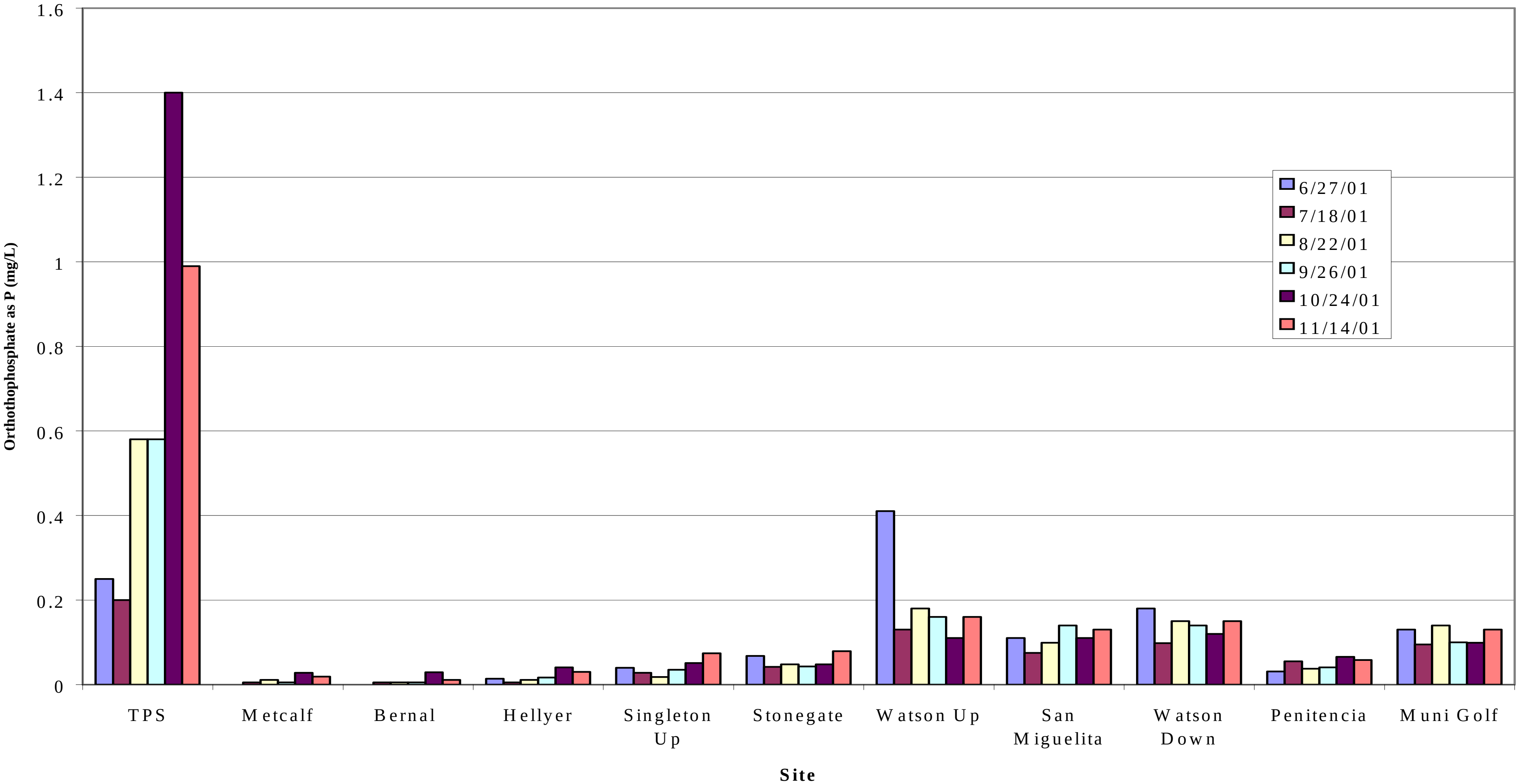

Figure III-22. Orthophosphate measured monthly at all Coyote Creek and tributary sites between August and November 2001.

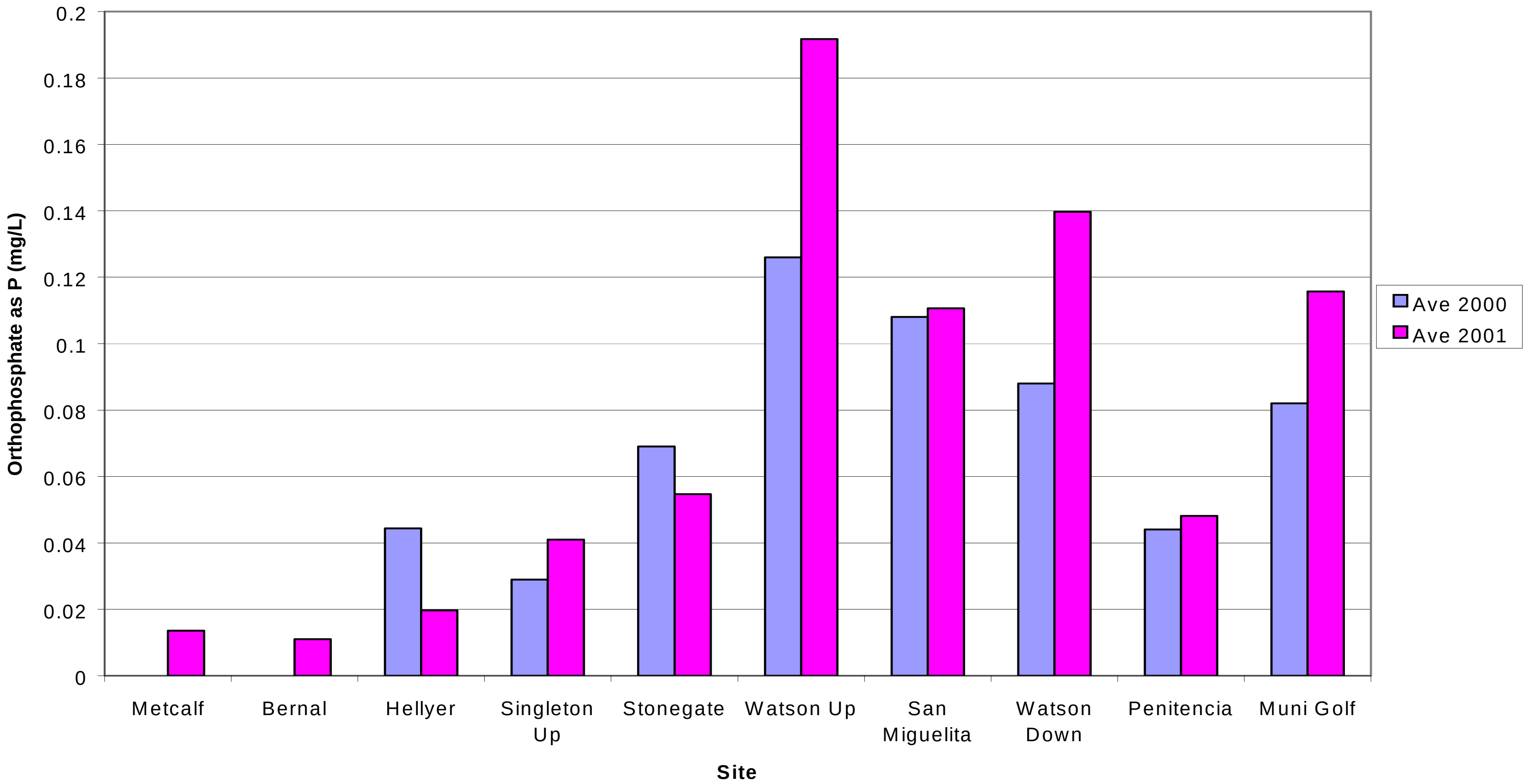

Figure III-23. Average orthophosphate for discrete monthly sampling at Coyote Creek and tributary sites between May and November 2000 and June and November 2001.

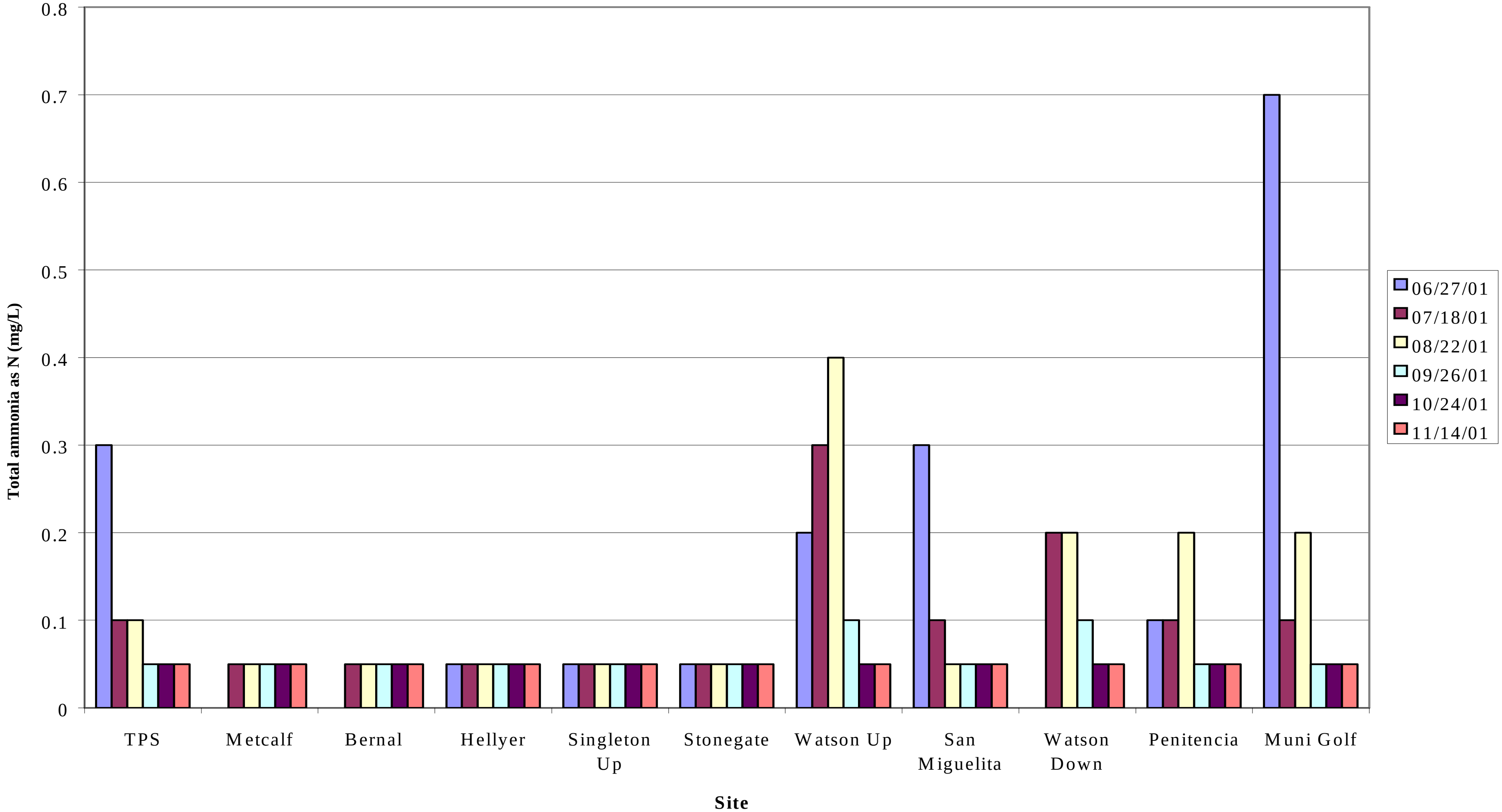

Figure III-24. Total ammonia ($NH_3 + NH_4^+$) measured monthly at all Coyote Creek and tributary sites between June and November 2001. Values < PQL of 0.1 mg/L NH_3-N were reported as 0.05 mg/L NH_3-N.

Ammonia Criterion and Potential Toxicity

The highest concentration of total ammonia was 0.7 mg/L as NH_3-N, measured at Muni Golf in June of 2001. This concentration is well below the temperature (19.6 ^oC) and pH (7.7) dependent Criterion Continuous Concentration (CCC) applicable when fish early life stages are present (USEPA, 2000); the calculated total ammonia concentration in Coyote Creek under these conditions should not exceed 2.58 mg N/L (Federal Register, 1999). Even when the highest pH (8.4) and highest temperature (22.0 ^oC) measured during the study period are applied to the highest ammonia value measured (worst-case scenario), the criterion of 0.796 mg/L NH_3-N is still not exceeded. Conditions of algae growth, increased light penetration, variability in sampling time (seasonal and diel), and numerous other factors could result in minor increases in pH and/or temperature that could cause ammonia criteria exceedances. Note that if the pH increased by 0.1 pH units to 8.5 and if the temperature increased by 2 ^oC to 24 ^oC, the CCC (0.591 mg N/L) would have been exceeded. Throughout the study period, the potential to exceed the ammonia criteria in the study site is present, however, since sites having the highest ammonia concentrations (*e.g.*, Muni Golf) did not have sufficiently high pH values to cause toxicity.

Total Kjeldahl Nitrogen

Total Kjeldahl Nitrogen (TKN) was analyzed by the CSJ for each site in 2001. The results were below the PQL (0.4 mg-N/L) on all but a few dates. San Miguelita Creek had TKN values above the PQL more often than any other site; the highest concentration measured there was 1.0 mg-N/L. Results are indicative of low levels of organic nitrogen in Coyote Creek.

Nitrite-Nitrogen

Nitrite-nitrogen was analyzed by the CSJ for each site in 2001. For many sites, the nitrite values were less than the PQL. Note that the PQL varied: in August and September, it was 0.05 mg-N/L; in October and November, the PQL was 0.003 mg-N/L. All of the sites from Metcalf to Stonegate, and for all of the sampling events, nitrite concentrations less than 0.025 mg-N/L were measured (Figure III-25). At the Watson Up site, however, nitrite-nitrogen concentrations increased significantly to nearly 0.35 mg-N/L. Concentrations were somewhat lower at Watson Down and dropped off significantly at Muni Golf.

Nitrate-Nitrogen

Figure III-26 shows the nitrate-nitrogen concentration at each site during each sampling event. In general, concentrations in the recycled water (TPS) are considerably higher than those measured in Coyote Creek and its tributaries. There is an apparent increase in concentration over time at all sites. A significant increase occurred between Watson Up and Watson Down due to the significant input from San Miguelita Creek. The average nitrate-nitrogen concentration at each site for 2000 and 2001 is shown in Figure III-27. Nitrate-nitrogen concentrations were substantially lower in 2001 than in 2000 at sites upstream of the confluence of Coyote Creek and San Miguelita Creek. However, at San Miguelita and Watson Down concentrations were higher in 2001 than in 2000. Penitencia Creek had very low concentrations of nitrate-nitrogen.

Total Organic Carbon

Total organic carbon (TOC) was analyzed by the CSJ for each site in 2001 (Figure III-28). TOC in the recycled water (TPS) varied little and ranged from 7.6 to 8.9 mg/L (mean = 8.2 mg/L).   Note that maximum concentrations were measured in June and September of 2001 at the Watson Up and downstream sites but not at the tributary sites. The average TOC concentrations measured at all Coyote Creek and tributary sites between June and November, 2001 are plotted in Figure III-29 and can be compared to that for recycled water (8.2 mg/L). At the Watson Up site, TOC concentrations increased significantly to an average of 16 mg/L. Typically, 80 to 90 percent of the total organic carbon was in the form of dissolved organic carbon (Appendix III-B).

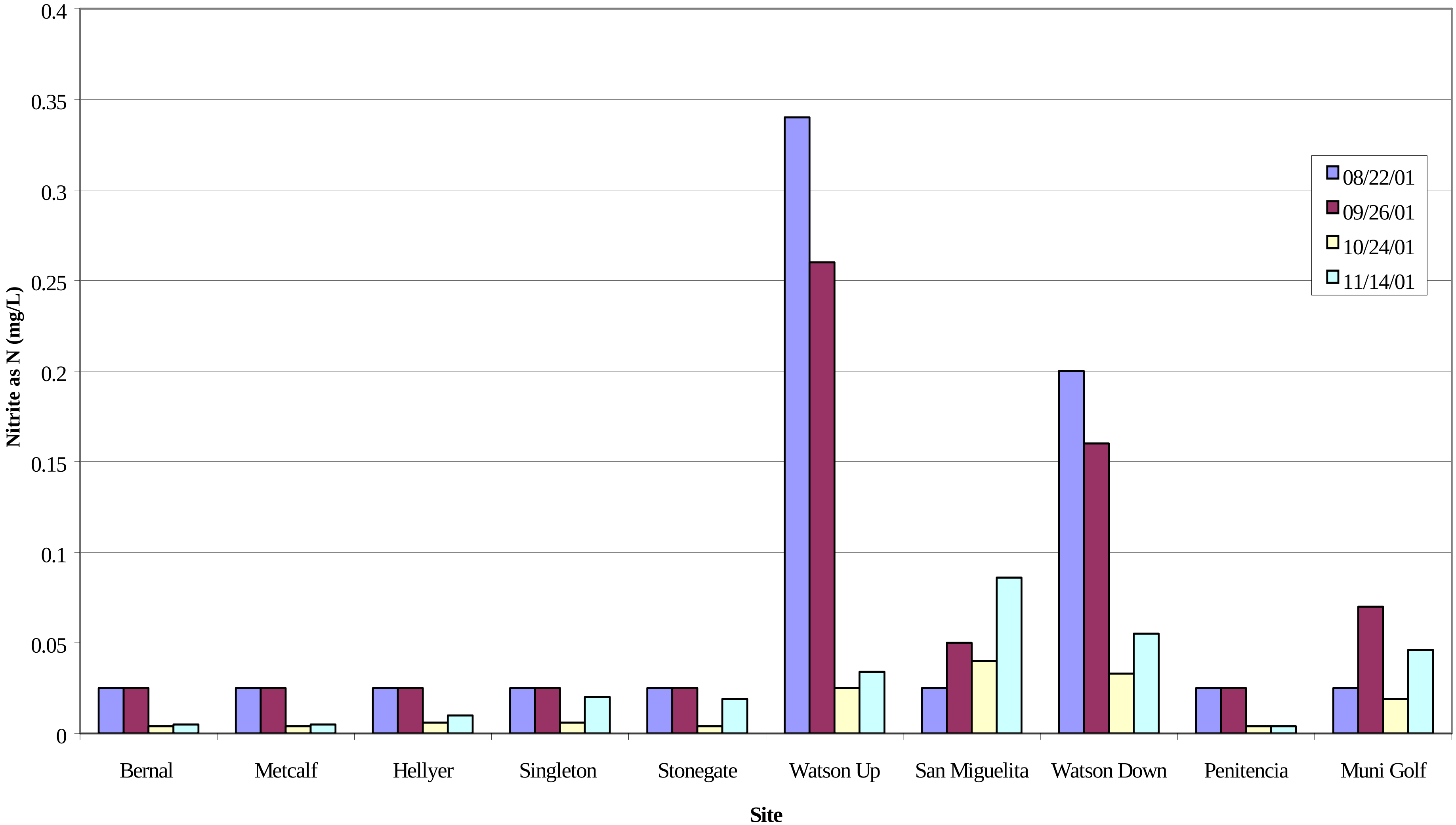

Figure III-25. Nitrite-nitrogen measured monthly at all Coyote Creek and tributary sites between August and November 2001.

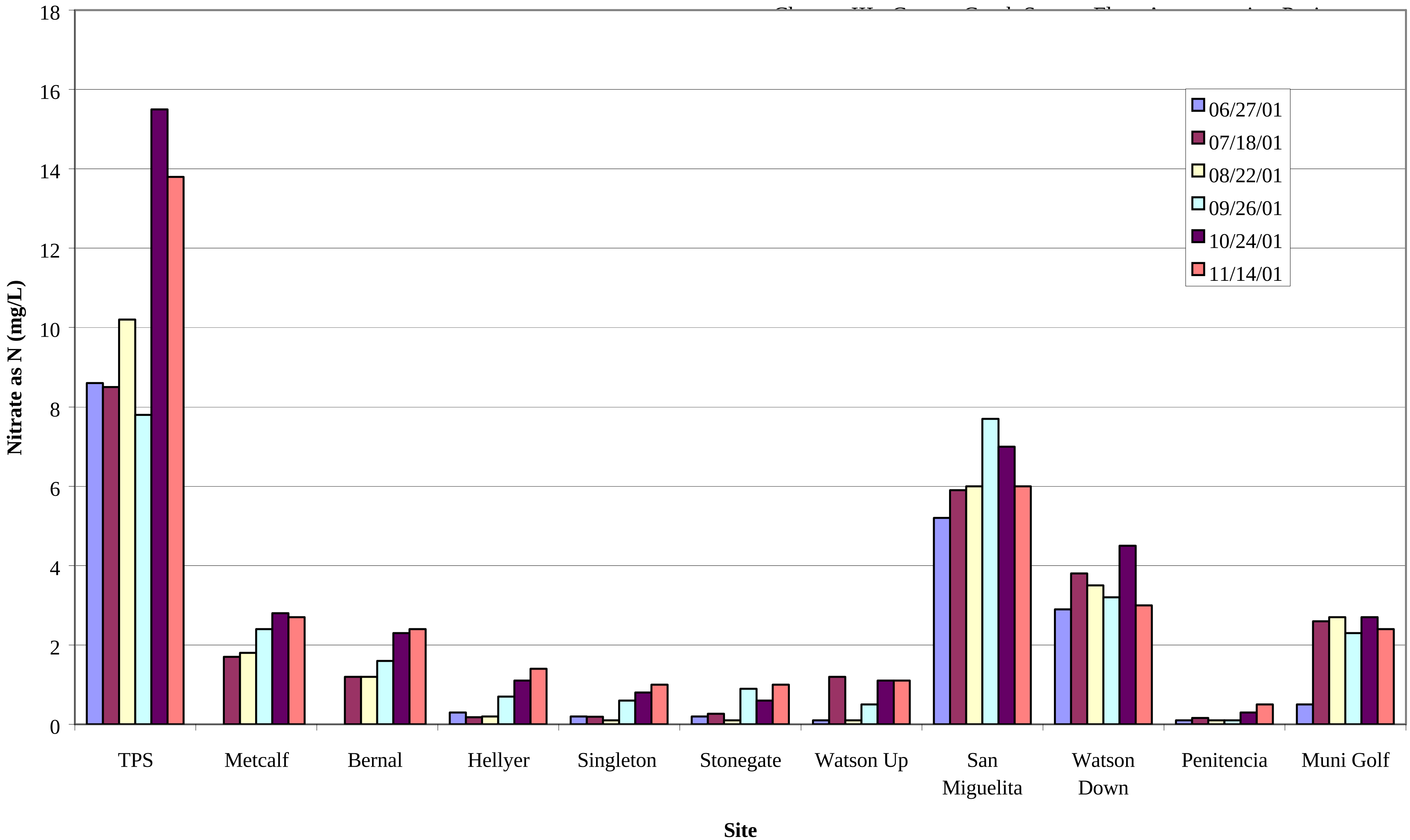

Figure III-26. Nitrate-nitrogen measured monthly at all Coyote Creek and tributary sites between June and November 2001.

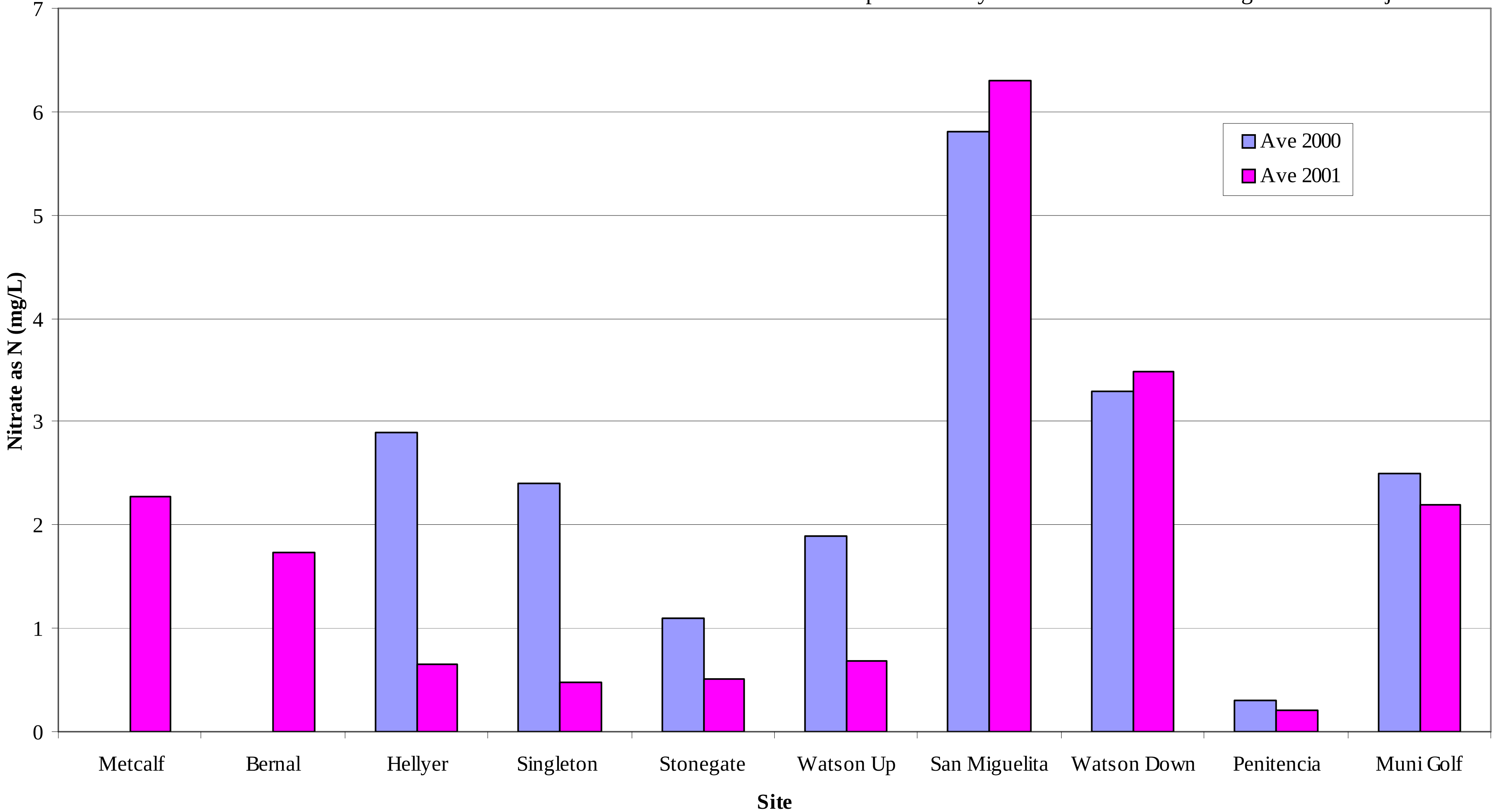

Figure III-27. Average nitrate-nitrogen for discrete monthly sampling at Coyote Creek and tributary sites between May and November 2000 and June and November 2001.

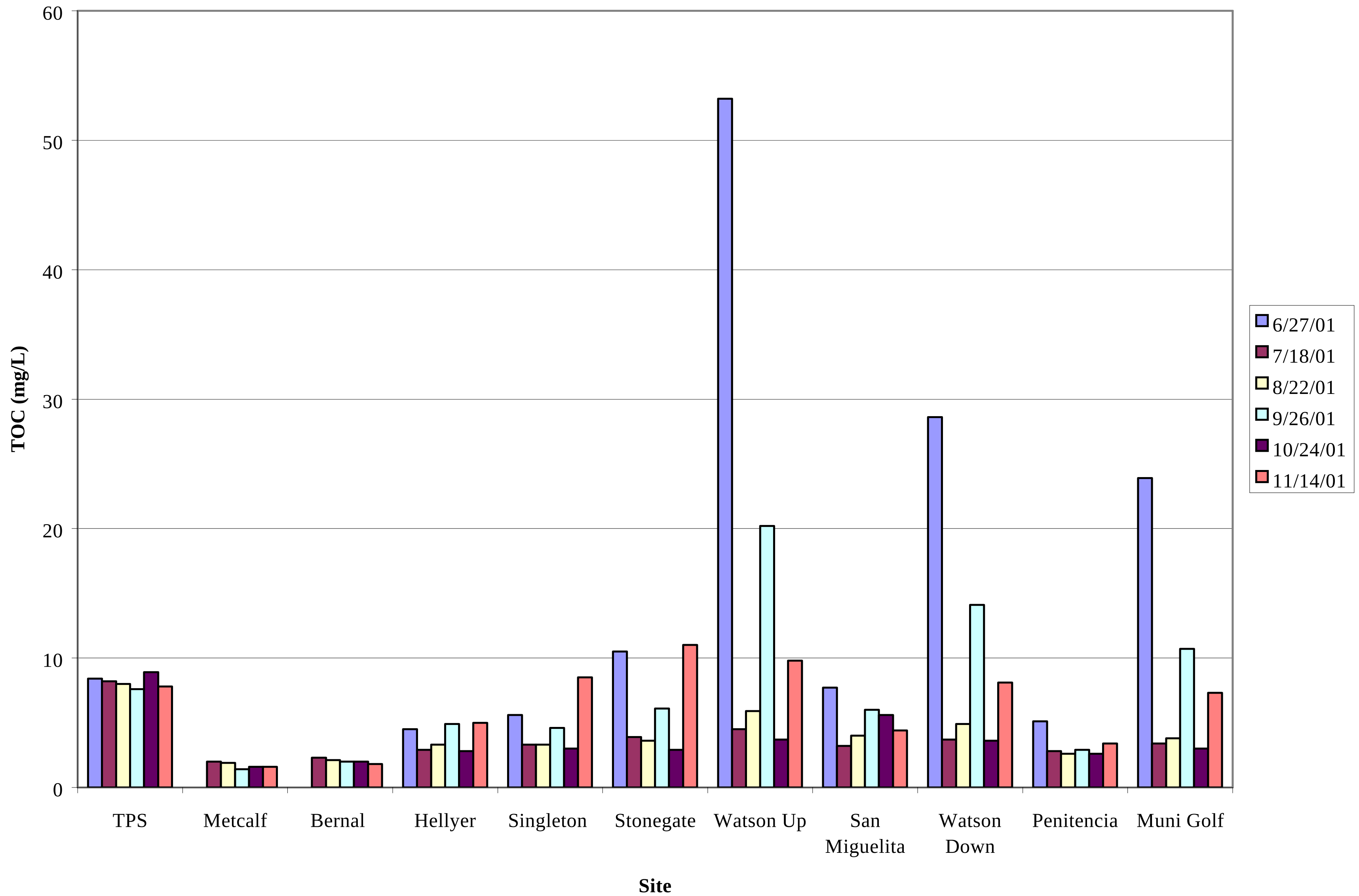

Figure III-28. Total organic carbon measured monthly at all Coyote Creek and tributary sites between June and November 2001.

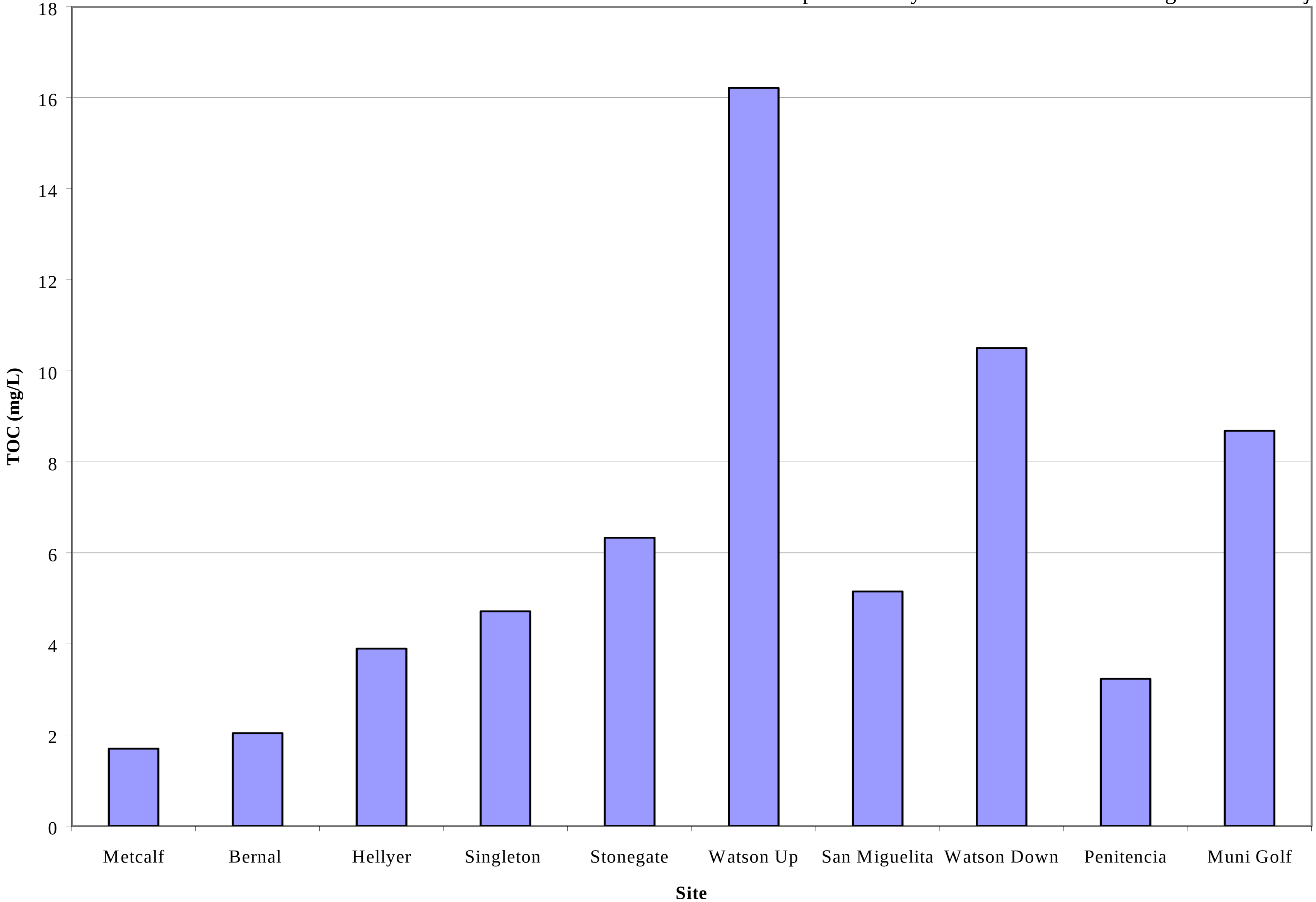

Figure III-29. Average TOC for discrete monthly sampling at Coyote Creek and tributary sites June and November 2001.

BIOLOGICAL CHARACTERISTICS

In this section, a description of the algae growth at each sampling site is provided. Analytical results pertaining to algae (phytoplanktonic and attached algae) growth in Coyote Creek and its tributaries are summarized. Vegetation (riparian and aquatic macrophyte) growth in Coyote Creek and its tributaries is described in Williamson and Hopkins (2001). Vegetation data were not collected in 2001.

Visual Observations

Visual observations of substrate and algae growth made at each site throughout the sampling period are summarized in this section.

Muni Golf:

The predominant alga at the Muni Golf site was identified as *Cladophora*. There were areas of exposed rock at this site that consisted of 95 percent cobble and 5 percent boulder. During the first sampling event on July 19, 2001, the cobbles on the left were covered 100 percent by algae; the growth was completely covered by a 0.5-inch thick layer of detritus. In August, 80 percent of the cobble was covered by short tufts of brown algae. By October, the cobble was covered 100 percent by brown, scruffy *Cladophora*. These results are similar to those measured in 2000.

Penitencia Creek:

The predominant alga was identified as *Cladophora*. Decaying algae of a red-brown color was observed. The long filaments of the algae that measured up to 2 feet in length in 2000 were not observed. This may be a result of moving the site to a more shaded spot downstream of a homeless person's camp. In August, the substrate was covered 100 percent by 1-3 inch long filaments of brown, decaying *Cladophora*. Regions where the detritus and brown algae had been sloughed off showed evidence of new, bright-green growths of algae. Large amounts of decaying *Cladophora* were common in September, 2000. During September, the strands were long, but the growth ranged in color from brown to greenish-brown. In October, the algae were olive colored and covered 90 percent of the substrate.

Watson Down:

The substrate was 100 percent sand and silt. Attached algae were not observed.   Similar to 2000, the water was usually brown or greenish-yellow and very turbid, which made it impossible to observe stream flora.

San Miguelita Creek:

The predominant alga at the San Miguelita Creek site was *Cladophora*. The substrate consisted of 25 percent sand or silt. During July, the substrate was covered 100 percent by 3 to 5 inch long filaments of *Cladophora* that were decaying and covered with silt.   In August, the cover and condition of the *Cladophora* was the same: brown, brittle, and decaying. Short, dark green filaments of *Cladophora* covered the substrate in September. This is similar to the growth pattern observed in August of 2000. In October, algae covered 90 percent of the substrate.

Watson Up:

Attached algae were not observed at Watson Up. The substrate was most likely 100 percent sand and silt. Similar to 2000, the water was usually brown or greenish-yellow and very turbid, which made it impossible to observe stream flora.

Stonegate:

The predominant filamentous alga at the Stonegate site was *Cladophora*. The substrate was primarily gravel and small cobbles. During the July sampling event, there were new, light green, sparse, delicate, filaments growing throughout the substrate. The filaments were typically very short (1-2 inches in length). The growth in September was sparse; green tufts less than 0.5 inches in length covered the substrate (100 percent cover).   Observations were not recorded in October and November.

Singleton:

Attached algae were not present at Singleton. The substrate at this site was muddy and interspersed with areas of gravel and cobble. Similar to 2000, the water was usually brown or greenish-yellow and very turbid, which made it impossible to observe stream flora.

Hellyer:

The predominant alga at the Hellyer site was *Cladophora*. Substrate at Hellyer consists primarily of gravel and cobbles. Algae cover in July was 80 percent; however, in sunny areas, a greater density of algae occurred. The substrate at this site was completely covered with scruffy, short, brown patches of decaying algae. The substrate was covered with insect larvae at this site. This situation continued through September. In October, the substrate was covered 30 percent by algae.

Bernal:

The predominant alga at the Bernal site was *Cladophora*. Algae cover in July was 100 percent. In August, algae length was estimated at six inches on some sections of rock. In general, the algae were green and abundant. In September, numerous insect larvae were observed. Rocks were covered 100 percent by a thick silt. A slimy layer of algae (1-2 inch long filaments) grew on the silt layer. In November, there were 4 to 5 foot long filaments of algae common at the site.

Metcalf:

In July, 10 percent of the cobble was covered by 3 to 5 foot long filaments of *Cladophora*. The sand and silt was covered 100 percent by algae. Downstream of the site, a dense growth of algae was observed. In August, the alga was 1 to 3 feet long in some locations, however the condition was described as scruffy. In October, 60 percent of the substrate was covered by algae.

Phytoplankton

Phytoplankton samples were collected from all creek sites during all sampling events. Figure III-30 shows the planktonic chlorophyll-a concentrations measured at each site during each sampling event. Note that the chlorophyll concentrations are corrected for phaeophytin. Elevated chlorophyll-a concentrations were measured at the Coyote Creek sites in July; a trend of decreased chlorophyll-a over time occurred. Chlorophyll concentrations were highest in the early parts of each sampling period, and decreased over time in both 2000 and 2001. The concentrations measured in July are typical of eutrophic systems. Figure III-31 shows the average of the planktonic chlorophyll-a concentrations measured at each site for 2000 and 2001. Chlorophyll concentrations in 2001 are considerably less than that measured in 2000 with the exception of the San Miguelita and Upper Penitencia Creek sites. Phaeophytin results obtained in 2001 are similar to those obtained in 2000. Approximately 10 percent of the chlorophyll was phaeophytin, indicating good health of the algae.

Attached algae

Attached algae samples were collected from cobbles and rocks at locations where the substrate enabled attached growth (Metcalf, Bernal, Hellyer, Stonegate, San Miguelita Creek, Penitencia Creek, and Muni Golf). Figure III-32 shows the attached chlorophyll-a concentration for each site during each sampling event. Note that the chlorophyll-a concentrations have been corrected for phaeophytin. By far, the highest algae biomass occurred at the tributary sites, with Penitencia Creek containing nearly three times the amount of biomass of other Coyote Creek sites. Figure III-33 shows the average attached algae chlorophyll-a concentration (corrected for phaeophytin) measured at all sites in 2000 and 2001. Attached algae data for 2001 are very similar to that measured in 2000. Tributary sites, particularly at San Miguelita Creek, contained less algae in 2001. Considerable construction activities up gradient of San Miguelita Creek may explain the results. Phaeophytin results (not plotted) were similar to that measured in 2000; on average, approximately 20 percent of the chlorophyll was phaeophytin.

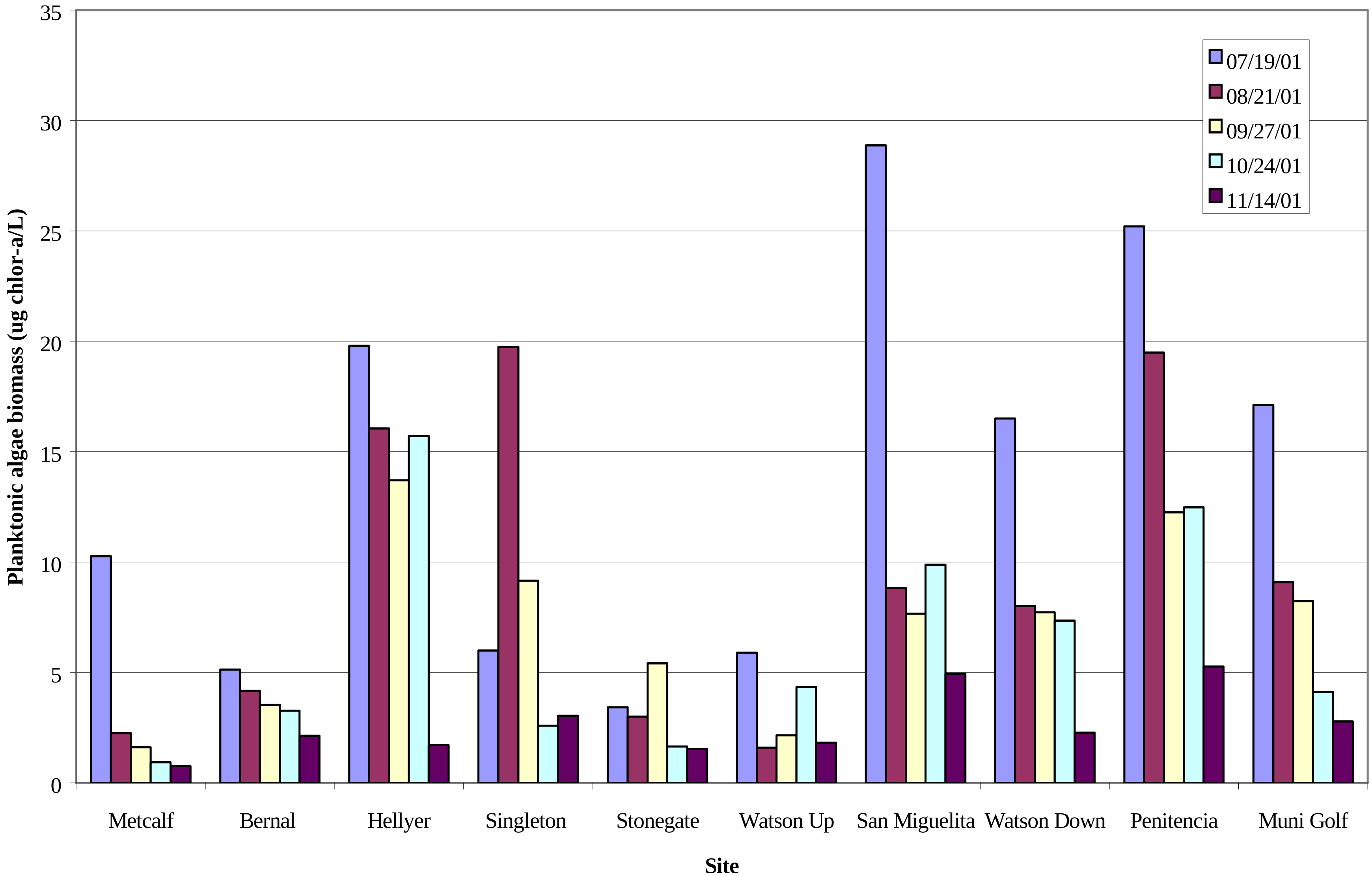

Figure III-30. Planktonic chlorophyll-a measured monthly at Coyote Creek and tributary sites between July and November 2001.

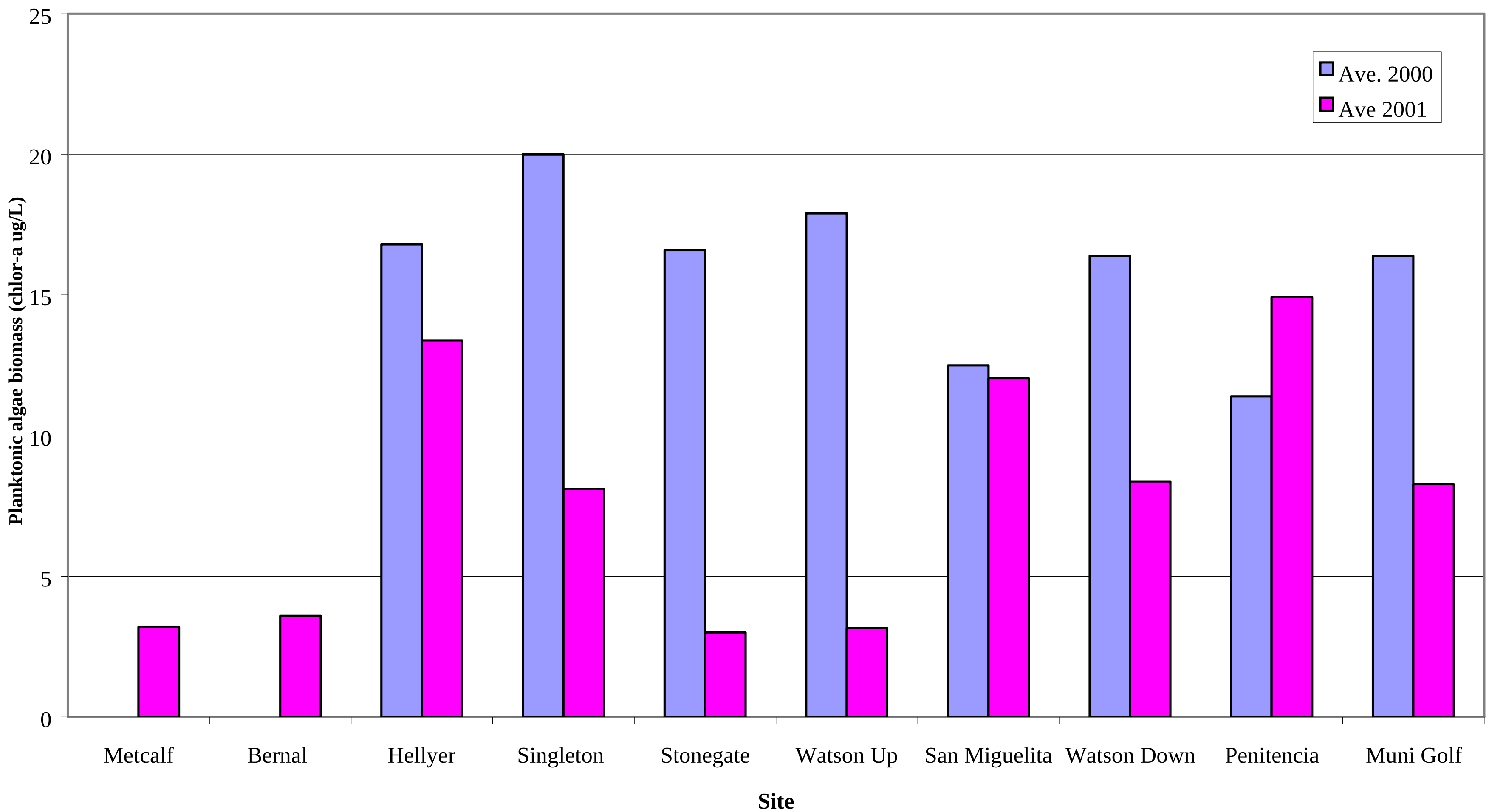

Figure III-31. Average planktonic chlorophyll-a for discrete monthly sampling at Coyote Creek and tributary sites between June and November 2000 and July and November 2001.

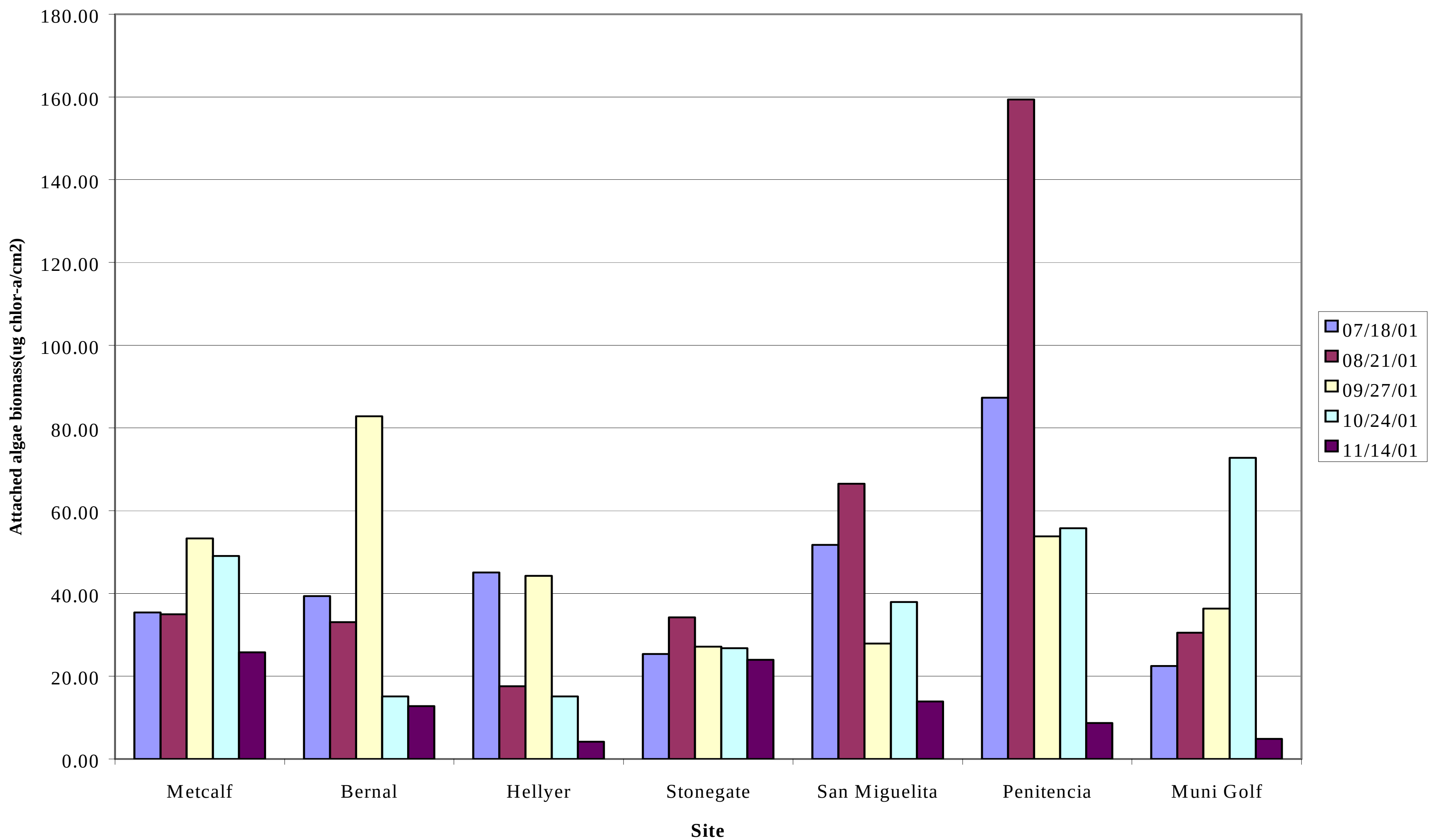

Figure III-32. Attached chlorophyll-a measured monthly at Coyote Creek and tributary sites between July and November 2001.

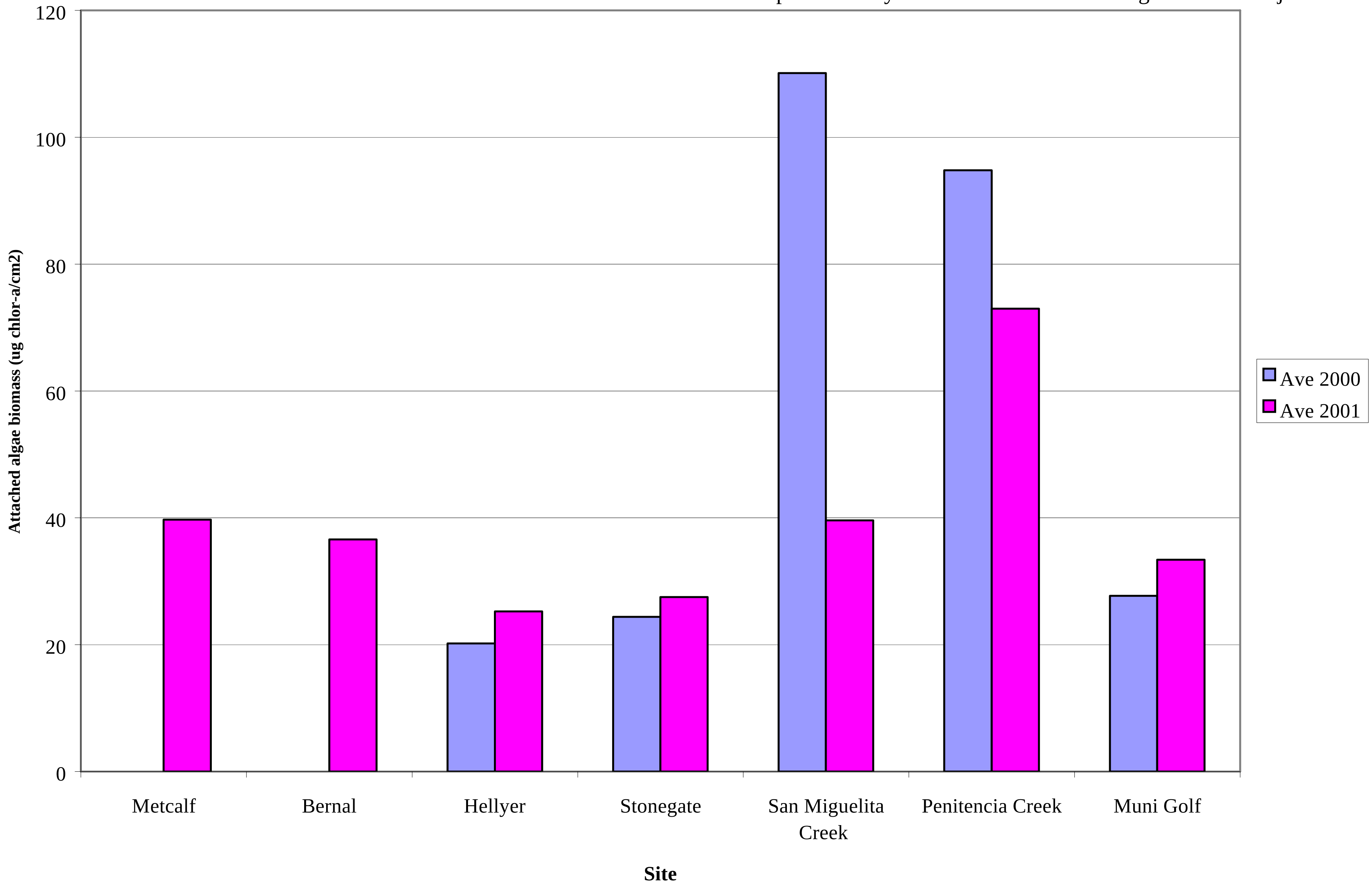

Figure III-33. Attached chlorophyll-a for discrete monthly sampling at Coyote Creek and tributary sites between July and November of 2000 and 2001.

DISCUSSION OF WATER QUALITY TRENDS IN COYOTE CREEK

In this section, the trends and relationships between parameters are described. Williamson and Hopkins (2001) provide a detailed discussion of the impacts of physical and chemical parameters on algae growth.

Canopy Effects

Canopy cover is one of the parameters used to determine the trophic status of a stream site (Newton *et. al*., 1999). Trophic status is useful in predicting how a stream might respond to changes in other parameters, such as nutrient loading. Once the trophic status of a water body is determined, informed and appropriate management strategies can be developed. Characterizing the trophic status of a site is not an easy process; the classification of a particular site is subject to change, especially in lotic environments. In Coyote Creek, decreases in percent canopy cover between the summer months and November serve as an example of the fact that trophic status classifications should not be considered as static conditions.

It is important to maintain or establish canopy cover near streams because it serves to control the growth of periphyton and phytoplankton by maintaining lower water temperatures, and by limiting the amount of light in the stream. The two tributary sites (San Miguelita Creek and Penitencia Creek) had the lowest canopy cover, the smallest depths, and the highest dissolved oxygen concentrations. These two sites typically had chlorophyll-a concentration higher than the Coyote Creek sites indicating the impact of reduced canopy cover and the effect of algae on dissolved oxygen.

Temperature Effects

Increases in water temperature result in an increase in metabolic activity of all organisms. This means increased rates of respiration and photosynthesis will occur with an increase in temperature. Temperature increases are a result of either solar radiation or the addition of warm-water flows. Therefore, maintaining canopy cover and controlling warm discharges into the creek are important.   Sites with the greatest algae growth were also the warmest sites monitored.

Discharge Effects

Discharge is a function of creek morphology and flow velocity. Discharge is greatly affected by releases from Anderson Reservoir, in addition to precipitation-related flows and stormwater discharges. The discharge from Anderson reservoir is typically an order of magnitude greater than that measured at the sampling sites in Coyote Creek and its tributaries. In 2001, the addition of two sites above Hellyer was instrumental in showing that considerable volumes of water may recharge the underlying groundwater basin. Tributaries to Coyote Creek also affect the overall discharge volumes. Discharge in Coyote Creek nearly doubled after the confluence of San Miguelita Creek. Of unknown impact are the multiple discharges from storm drains throughout the system. These data are in agreement with those collected in 2000.

Turbidity and TSS Effects

In 2001, the turbidity and total suspended solids concentration increased from Metcalf to the Stonegate site. The effect of the two tributaries on these parameters was apparent: elevated turbidity and TSS in San Miguelita Creek increased levels in Coyote Creek; low turbidity and TSS in Penitencia Creek decreased levels in Coyote Creek. Activities along the creek that exacerbate these parameters include construction, disturbances in the creek bed by SCVWD cleanup and channel clearing activities, storm drain discharges, and human activity in and around the creek (*e.g.,* homeless encampments, fishing, swimming and playing).

In general, the water was so turbid that the creek bottom could only be seen at Metcalf, Bernal, Hellyer, San Miguelita Creek, Penitencia Creek, and on the left side of the transect at Muni Golf. The creek bottom at all of the other sites was seldom observed. The presence of suspended matter in water scatters light, which reduces the depth of penetration. The result is that plant and algae growth is limited by the depth of light penetration. A change in these parameters could be enough to change the trophic status; increased turbidity could prevent growth where it previously existed, and increased clarity could promote growth where none had been before.

Dissolved Oxygen and Percent Saturation Effects

Dissolved oxygen concentrations were typically low in Coyote Creek, with average concentrations less than 8.0 mg/L. The lowest dissolved oxygen concentrations were always measured at Watson Up, with 2 to 4 mg/L typical. This site is a low flow, stagnant site with an anaerobic substrate. The Penitencia Creek site was always high relative to the Coyote Creek sites. Sites with the highest dissolved oxygen concentrations were generally those with a cobble substrate covered with attached algae (San Miguelita Creek, Penitencia Creek, Stonegate, Hellyer, Bernal, and Metcalf). Sites with the lowest dissolved oxygen concentrations were characterized by sand/silt and clay substrates; an anaerobic hydrogen sulfide odor was usually noted during sampling. In general, many sites had oxygen concentrations lower than the minimum concentration required for a cold water fish habitat. This was particularly evident at Watson Up. In 2001, average concentrations at Hellyer, Stonegate, Watson Up, Watson Down, and Muni Golf were at or below the 7 mg/L requirement, (CRWQCB-SFBR, 1986).

On average, the Coyote Creek sites were always undersaturated with respect to dissolved oxygen. Tributary sites and the Bernal site were greater than 90 percent or were supersaturated with respect to dissolved oxygen. Once again, these sites were characterized by low canopy cover and 100 percent algae cover on a cobble substrate.

Phytoplankton

The average concentration of algae in the water column was at its highest in early and late June, 2000 and in July 2001. Note that these sampling events represent the earliest dates of collection. Phytoplankton concentrations decreased between July and November of 2001 at all sites; this same trend was observed in 2000. The highest phytoplankton biomass was measured at Penitencia Creek; in 2000, this site had one of the lowest concentrations of algae. With the exception of Penitencia Creek, concentrations of chlorophyll-a were much lower in 2001 than in 2000. This may be a result of lower temperatures and considerable amounts of settled solids deposited in the creek. Deposition at Watson Down was significant: in 2000, sampling required chest waders; in 2001, knee boots were sufficient.

Watson Down is downstream of San Miguelita Creek, which experienced very high turbidity related to construction at the confluence with Silver Creek.

Attached Algae

Only 7 of the 10 creek sites were suitable for attached algae collection because of the substrate composition. These sites were Metcalf, Bernal, Hellyer, Stonegate, San Miguelita Creek, Penitencia Creek, and Muni Golf. The two sites with the least percent canopy cover, San Miguelita Creek and Penitencia Creek, had the highest concentrations of attached algae, although concentrations were considerably lower than that measured in 2000.

DATA TRENDS

Data are summarized with respect to trends in this section. Factors controlling algae growth are summarized. The conceptual relationships that exist between the parameters monitored and algae growth are summarized in Table III-2. Note that the impact of an increase in algae growth on the parameter and the impact of an increase in a parameter on algae growth are related; the effects are often the opposite. For example, an increase in water velocity results in an increase in algae growth in that 1) detritus, silt, and epiphytes are removed and 2) there is an increased flux of nutrients across the cell membrane. On the other hand, an increase in algae growth can result in a decrease in flow velocity by increasing the drag coefficient. This can result in changes in stream velocity in other parts of the transect or changes in creek morphology.

Table III-2. Conceptual relationships between water quality parameters and algae growth in natural systems. NC means no change

Parameter	Impact of Increased Algae Growth on Parameter	Impact of Increased Parameter on Algae Growth
Canopy Cover	NC	↓
Water Temperature	↓	↑
Velocity	↓	↑
PH	↑	NC
Turbidity	↑	↓
Dissolved Oxygen	↑	NC, unless C-limited
Boulder/Cobble Substrate Type	NC	↑
Inorganic Nitrogen	↓	↑, if limiting nutrient
Phosphorus	↓	↑, if limiting nutrient

Increased water temperature, velocity, substrate type (towards more boulder/cobble) and inorganic nitrogen are expected to result in an increase in algae growth. Increased canopy cover and turbidity are expected to result in a decrease in algae growth. When analyzing 2000 data, a ranking of water quality parameters associated with attached algae growth using the data provided in Appendix III-A was made. Results of this analysis are provided in Appendix III-E.

Data trends for 2001 were similar to those in 2000. Sites with low canopy cover, higher velocities, substrate for attachment, and warmer temperatures had elevated concentrations of attached chlorophyll. Concentrations of dissolved oxygen were elevated at sites with attached algae. Attached algae growth patterns were likewise comparable. Average concentrations of attached algae measured at all sites in 2000 and 2001 were similar except for that measured at San Miguelita Creek, where considerable construction activity was noted up gradient of the sampling site. Planktonic algae biomass measured in the tributary sites were similar in 2000 and 2001. Concentrations did not change in San Miguelita Creek; in Penitencia Creek, the planktonic algae biomass increased. Planktonic algae biomass, however, was quite different in the Coyote Creek sites. A decrease in chlorophyll-a was measured at all creek sites in 2001 relative to 2000, with the lowest concentrations of planktonic algae biomass measured at Stonegate and Watson Up. Concentrations remain low downstream to Muni Golf, despite elevated concentrations in the tributaries. Possible explanations include seasonal variability, climate and weather patterns, and/or the discharge of inhibitory substances.

The potential for discharge of inhibitory substances is high. While measurement of a specific algae toxicant was not made, it is notable that Watson Up had the highest total dissolved solids, nutrient concentrations (total phosphorus, soluble reactive phosphorus, orthophosphate, total ammonia, and nitrite nitrogen), total organic carbon, dissolved organic carbon, and biochemical oxygen demand of all Coyote Creek sites monitored. In addition, the turbidity and total suspended solids concentration at Watson Up were always lower than what was measured in the nearest upstream site (Stonegate), indicating either settling of solids or the input of water with fewer suspended solids. Likewise, the pH, dissolved oxygen, and percent oxygen saturation were always lower at Watson Up than at any other site. These observations indicate a reach of the creek where organic loading is occurring. The chemical composition of whatever is being discharged at or above this site is unknown but could include inhibitory substances.

In summary, algae growth in Coyote Creek and its tributaries was as expected given the morphology of the sites, the amounts of canopy cover, substrate types, and other creek conditions. The qualitative assessment of data collected in 2001 indicates that for the most part, attached algae are not likely to be a concern in most of Coyote Creek, unless conditions change resulting in enhanced growth conditions, *e.g.*, increased substrate for attachment or light become available. Likewise, concentrations of planktonic algae were low, indicating creek conditions not conducive to algae growth, despite elevated nutrient concentrations.

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APPENDICES

Appendix III-A: Raw data for 2000 collected by SJSU

TABLE III-A1. COYOTE CREEK WATER QUALITY DATA SHEET

SAMPLING DATE: MAY 2-3, 2000

Station Name	Station ID	Date	Time	Water Temp. °C	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO_4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm^2	Attached Algal Phaeophytin, ug chlor-a/cm^2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	5/2/00	11:40	19.0	7.9	8.3	nc	1354	3.76	<0.1	0.05	nc	nc	18	nc	nc	nc	nc
Penitencia Creek	SJPC2	5/2/00	9:20	16.7	8.3	9.9	nc	726	0.35	<0.1	0.01	nc	nc	9	nc	nc	nc	nc
Watson Park Down	SJCCBSMC	5/2/00	9:50	17.7	7.8	7.5	nc	1445	4.44	0.11	0.05	nc	nc	16	nc	nc	nc	nc
San Miguelita Creek	SJSMC	5/2/00	10:40	18.7	8.1	10.0	nc	1705	6.66	0.12	0.05	nc	nc	8	nc	nc	nc	nc
Watson Park Up	SJCCASMC	5/2/00	10:20	17.0	7.6	6.5	nc	1143	1.97	<0.1	0.05	nc	nc	14	nc	nc	nc	nc
Stonegate	SJCCBDis	5/3/00	9:15	17.9	8.2	7.6	15.7	687	0.82	<0.1	0.02	nc	nc	20	nc	nc	nc	nc
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	5/3/00	9:45	18.2	8.4	8.4	17.3	665	0.80	<0.1	0.02	nc	nc	23	nc	nc	nc	nc
Hellyer Park	SJCCHel	5/3/00	10:20	18.4	8.1	7.8	16.7	585	1.21	<0.1	0.01	nc	nc	22	nc	nc	nc	nc

Field Data Entered By: JLH

Nutrient and Turbidity Analysis   by CSJ Lab
Performed By CSJ Lab
N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt, R = Rock, S = Sand

TABLE III-A2. COYOTE CREEK WATER QUALITY DATA SHEET **SAMPLING DATE: JUNE 5-7, 2000**

Station Name	Station ID	Date	Time	Water Temp. oC	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm2	Attached Algal Phaeophytin, ug chlor-a/cm2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	6/7/00	10:45	19.9	7.8	8.2	24.00	980	2.20	<0.1	0.09	84	21.5	na	nc	nc	24.5	0.9
Penitencia Creek	SJPC2	6/5/00	2:55	23.5	8.9	9.9	9.40	430	0.19	<0.1	0.04	27	1.7	na	nc	nc	12.8	0.0
Watson Park Down	SJCCBSMC	6/7/00	10:20	18.6	8.0	8.2	13.80	1432	3.40	<0.1	0.09	91	29.3	na	nc	nc	25.6	0.0
San Miguelita Creek	SJSMC	6/6/00	11:40	19.0	8.2	11.3	8.50	1680	1.10	<0.1	0.06	1	11.2	na	nc	nc	10.3	0.2
Watson Park Up	SJCCASMC	6/6/00	12:51	18.9	7.7	5.4	22.70	1119	6.50	<0.1	0.12	91	nc	na	nc	nc	54.4	0.7
Stonegate	SJCCBDis	6/6/00	1:50	20.0	7.9	7.3	29.5	600	0.52	<0.1	0.04	67	nc	na	nc	nc	28.8	1.1
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	6/7/00	9:23		7.9	7.4	19.3	550	0.47	<0.1	0.03	60	6.4	na	nc	nc	42.5	2.0
Hellyer Park	SJCCHel	6/7/00	9:47		7.7	7.6	17.7	500	1.10	<0.1	0.03	78	5.6	na	nc	nc	18.3	0.7

Field Data Entered By: JLH

Nutrient and Turbidity Analysis by CSJ Lab
Performed By CSJ Lab
N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt, R = Rock, S = Sand

TABLE III-A3. COYOTE CREEK WATER QUALITY DATA SHEET

SAMPLING DATE: JUNE 27, 2000

Station Name	Station ID	Date	Time	Water Temp. oC	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm2	Attached Algal Phaeophytin, ug chlor-a/cm2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	6/27/00	10:07	22.2	8.0	7.3	nc	890	na	na	na	nc	21.1	na	nc	nc	27.0	1.0
Penitencia Creek	SJPC2	6/27/00	11:25	24.0	8.8	10.2	nc	312	na	na	na	nc	2.1	na	nc	nc	9.1	0.3
Watson Park Down	SJCCBSMC	6/27/00	12:30	23.0	8.0	9.8	nc	1250	na	na	na	nc	15.8	na	nc	nc	29.1	2.9
San Miguelita Creek	SJSMC	6/27/00	15:00	27.0	8.3	12.6	nc	1620	na	na	na	nc	6.0	na	nc	nc	8.2	0.0
Watson Park Up	SJCCASMC	6/27/00	14:00	23.0	7.7	6.5	nc	9900	na	na	na	nc	7.8	na	nc	nc	33.8	4.7
Stonegate	SJCCBDis	6/27/00	17:02	24.5	8.2	8.6	nc	590	na	na	na	nc	4.8	na	nc	nc	45.9	8.7
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	6/27/00	17:51	25.1	8.3	8.8	nc	482	na	na	na	nc	6.4	na	nc	nc	38.5	7.4
Hellyer Park	SJCCHel	6/27/00	18:47	24.2	8.2	8.0	nc	470	na	na	na	nc	6.0	na	nc	nc	14.5	3.5

Field Data Entered By: JLH

Nutrient and Turbidity Analysis Performed By CSJ Lab   by CSJ Lab

N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt, R = Rock, S = Sand

TABLE III-A4. COYOTE CREEK WATER QUALITY DATA SHEET

SAMPLING DATE: JULY 11, 2000

Station Name	Station ID	Date	Time	Water Temp. oC	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm2	Attached Algal Phaeophytin, ug chlor-a/cm2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	7/11/00	9:40	19.8	na	7.7	19.7	1015	2.30	<0.1	0.11	nc	21.1	32	nc	nc	nc	nc
Penitencia Creek	SJPC2	7/11/00	10:21	19.9	na	10.0	9.4	311	0.10	<0.1	0.07	nc	2.2	16	nc	nc	nc	nc
Watson Park Down	SJCCBSMC	7/11/00	11:01	19.6	na	7.9	24.1	1313	3.70	<0.1	0.11	nc	13.8	40	nc	nc	nc	nc
San Miguelita Creek	SJSMC	7/11/00	0:09	21.1	na	11.1	23.7	1669	6.40	<0.1	0.09	nc	6.6	30	nc	nc	nc	nc
Watson Park Up	SJCCASMC	7/11/00	11:37	19.4	na	5.7	14.2	900	1.20	<0.1	0.12	nc	8.4	21	nc	nc	nc	nc
Stonegate	SJCCBDis	7/11/00	13:51	21.7	na	8.6	16.6	567	0.69	<0.1	0.03	nc	4.5	23	nc	nc	nc	nc
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	7/11/00	14:35	22.7	na	7.0	10.3	579	7.00	<0.1	0.02	nc	6.6	13	nc	nc	nc	nc
Hellyer Park	SJCCHel	7/11/00	15:14	22.9	na	8.9	12.2	494	6.60	<0.1	0.01	nc	5.9	16	nc	nc	nc	nc

Field Data Entered By: JLH

Nutrient Lab Analysis Performed By: CSJ Lab

N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt, R = Rock, S = Sand

TABLE III-A5. COYOTE CREEK WATER QUALITY DATA SHEET

SAMPLING DATE: JULY 18, 2000

Station Name	Station ID	Date	Time	Water Temp. oC	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm2	Attached Algal Phaeophytin, ug chlor-a/cm2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	7/18/00	9:40	19.8	8.0	7.7	12.6	1015	na	na	na	nc	21.1	na	25.8	5.9	18.0	1.3
Penitencia Creek	SJPC2	7/18/00	10:21	19.9	8.8	10.0	5.9	311	na	na	na	nc	2.2	na	40.2	10.8	7.7	0.3
Watson Park Down	SJCCBSMC	7/18/00	11:01	19.6	7.9	7.9	17.2	1313	na	na	na	nc	13.8	na	nc	nc	15.7	1.7
San Miguelita Creek	SJSMC	7/18/00	12:09	21.1	8.2	11.1	20.9	1669	na	na	na	nc	6.6	na	56.1	14.4	11.6	1.2
Watson Park Up	SJCCASMC	7/18/00	11:37	19.4	7.7	5.7	13.4	900	na	na	na	nc	8.4	na	nc	nc	18.9	1.4
Stonegate	SJCCBDis	7/18/00	13:51	21.7	8.0	8.6	18.4	567	na	na	na	nc	4.5	na	17.6	4.2	10.3	0.0
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	7/18/00	14:35	22.7	8.1	7.0	11.2	579	na	na	na	nc	6.6	na	nc	nc	15.0	1.7
Hellyer Park	SJCCHel	7/18/00	15:14	22.9	8.2	8.9	9.5	494	na	na	na	nc	5.9	na	13.6	2.5	23.6	0.0

Field Data Entered By:JLH

Nutrient Lab Analysis Performed By: CSJ Lab

N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt, R = Rock, S = Sand

TABLE III-A6. COYOTE CREEK WATER QUALITY DATA SHEET

SAMPLING DATE:AUGUST 1-2, 2000

Station Name	Station ID	Date	Time	Water Temp. oC	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm2	Attached Algal Phaeophytin, ug chlor-a/cm2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	8/1/00	8:30	na	8.0	na	12.60		2.30	<0.1	0.10	90	15.6	18	19.9	4.8	28.7	3.2
Penitencia Creek	SJPC2	8/1/00	9:06	na	8.0	na	5.90		0.10	<0.1	0.07	33	2.9	8	114.3	42.1	9.8	1.1
Watson Park Down	SJCCBSMC	8/1/00	9:38	na	7.9	na	17.20		3.70	<0.1	0.11	92	13.6	24	nc	nc	24.9	4.5
San Miguelita Creek	SJSMC	8/1/00	9:53	na	8.0	na	20.90		6.40	<0.1	0.09	2	12.2	30	123.8	43.4	25.8	1.0
Watson Park Up	SJCCASMC	8/1/00	9:46	na	7.6	na	13.40		1.20	<0.1	0.12	92	1.8	19	nc	nc	19.4	3.3
Stonegate	SJCCBDis	8/1/00	10:30	na	7.9	na	18.40		0.69	<0.1	0.03	89	8.9	35	8.3	1.2	25.6	5.5
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	8/1/00	11:00	na	8.0	na	11.2		7.00	<0.1	0.04	62	6.5	14	nc	nc	18.9	2.6
Hellyer Park	SJCCHel	8/1/00	11:18	na	8.2	na	9.50		6.60	<0.1	0.01	92	6.2	12	7.0	1.2	23.6	4.7

Field Data Entered By: JLH

Nutrient Lab Analysis Performed By: CSJ Lab

N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt, R = Rock, S = Sand

TABLE III-A7. COYOTE CREEK WATER QUALITY DATA SHEET **SAMPLING DATE: AUGUST 15-16, 2000**

Station Name	Station ID	Date	Time	Water Temp. oC	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm2	Attached Algal Phaeophytin, ug chlor-a/cm2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	8/15/00	7:08	20.3	7.6	7.6	na	1125	na	na	na	88	15.7	na	37.2	10.6	10.6	0.5
Penitencia Creek	SJPC2	8/15/00	8:06	18.7	8.1	9.5	na	320	na	na	na	40	2.3	na	86.7	30.3	10.9	1.0
Watson Park Down	SJCCBSMC	8/15/00	8:54	19.2	7.5	6.3	na	1308	na	na	na	90	14.7	na	nc	nc	15.6	0.8
San Miguelita Creek	SJSMC	8/15/00	9:25	19.1	7.4	8.6	na	1626	na	na	na	7	11.6	na	150.3	55.4	19.6	3.4
Watson Park Up	SJCCASMC	8/15/00	9:10	19.7	7.7	4.3	na	934	na	na	na	94	5.0	na	nc	nc	6.3	0.0
Stonegate	SJCCBDis	8/15/00	10:25	20.4	8.0	7.3	na	549	na	na	na	92	8.0	na	31.6	7.7	8.3	0.3
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	8/15/00	11:20	21.6	7.7	6.1	na	501	na	na	na	35	6.5	na	nc	nc	7.3	0.0
Hellyer Park	SJCCHel	8/15/00	13:00	22.0	8.0	7.1	na	498	na	na	na	88	6.2	na	28.0	1.0	15.6	1.9

Field Data Entered By: JLH

Nutrient and Turbidity Analysis Performed By CSJ Lab   by CSJ Lab

N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt, R = Rock, S = Sand

TABLE III-A8. COYOTE CREEK WATER QUALITY DATA SHEET

SAMPLING DATE: SEPTEMBER 6, 2000

Station Name	Station ID	Date	Time	Water Temp. oC	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm2	Attached Algal Phaeophytin, ug chlor-a/cm2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	9/5/00	3:30	19.1	7.5	7.5	17.20	1063	2.70	0.10	0.20	84	22.9	23	28.2	7.0	7.9	0.8
Penitencia Creek	SJPC	9/5/00	2:50	21.5	8.4	10.0	7.50	342	<0.03	<0.1	0.07	27	2.0	13	130.3	48.2	8.1	1.4
Watson Park Down	SJCCBSMC	9/5/00	1:40	18.9	7.7	6.9	26.30	1263	3.60	0.10	0.19	91	11.2	42	nc	nc	9.2	0.0
San Miguelita Creek	SJSMC	9/5/00	2:13	20.5	7.9	9.7	37.10	1601	6.80	<0.1	0.20	1	9.5	59	55.9	17.4	11.1	1.3
Watson Park Up	SJCCASMC	9/5/00	2:24	17.9	7.4	4.8	14.80	916	1.00	0.10	0.22	91	5.2	22	nc	nc	4.7	0.0
Stonegate	SJCCBDis	9/5/00	12:30	17.9	7.7	8.4	24.00	570	0.69	<0.1	0.11	67	5.5	30	28.5	7.4	5.7	0.0
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	9/5/00	11:21	18.2	7.5	7.8	14.00	507	0.74	<0.1	0.07	60	6.8	16	nc	nc	26.0	3.1
Hellyer Park	SJCCHel	9/5/00	10:30	18.9	7.7	8.1	13.40	501	0.84	<0.1	0.04	78	5.6	16	23.6	12.0	15.1	2.8

Field Data Entered By: JLH

Nutrient and Turbidity Analysis   by CSJ Lab
Performed By CSJ Lab
N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt,
R = Rock, S = Sand

TABLE III-A9. COYOTE CREEK WATER QUALITY DATA SHEET

SAMPLING DATE: OCTOBER 3, 2000

Station Name	Station ID	Date	Time	Water Temp. oC	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm2	Attached Algal Phaeophytin, ug chlor-a/cm2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	10/3/00	8:36	18.6	7.7	8.5	17.70	1118	2.90	<0.1	0.02	nc	nc	22	41.0	10.0	11.4	1.5
Penitencia Creek	SJPC2	10/3/00	9:15	17.8	7.5	9.8	12.20	412	0.05	<0.1	0.04	nc	nc	22	75.2	23.3	20.6	3.0
Watson Park Down	SJCCBSMC	10/3/00	9:49	17.8	7.7	6.4	23.70	1228	3.10	0.10	0.05	nc	nc	32	nc	nc	7.7	0.0
San Miguelita Creek	SJSMC	10/3/00	10:29	17.8	7.9	9.2	32.00	1593	6.40	<0.1	0.15	nc	nc	46	140.6	40.8	9.9	0.5
Watson Park Up	SJCCASMC	10/3/00	10:02	18.0	7.4	4.3	11.60	923	0.08	0.10	0.13	nc	nc	14	nc	nc	3.2	0.0
Stonegate	SJCCBDis	10/3/00	10:52	17.8	7.7	7.7	19.70	550	0.69	<0.1	0.14	nc	nc	29	46.1	11.8	6.8	0.0
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	10/3/00	11:28	18.0	7.8	7.3	15.20	550	0.71	<0.1	0.03	nc	nc	23	nc	nc	4.8	0.3
Hellyer Park	SJCCHel	10/3/00	11:51	18.4	7.7	7.5	12.90	506	0.21	<0.1	0.10	nc	nc	17	29.9	7.2	22.0	5.5

Field Data Entered By: JLH

Nutrient and Turbidity Analysis by CSJ Lab
Performed By CSJ Lab

N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt,
R = Rock, S = Sand

TABLE III-A10. COYOTE CREEK WATER QUALITY DATA SHEET

SAMPLING DATE: NOVEMBER 11, 2000

Station Name	Station ID	Date	Time	Water Temp. oC	pH	D.O., mg/L	Turbidity, NTU	Conduct., umohs/cm	Nitrate, mg N/L	ammonia mg N/L	O-phosphate mg PO4/L	% Canopy Cover	discharge, cfs	Suspend Solids, mg/L	Attached Algae, ug chlor-a/cm2	Attached Algal Phaeophytin, ug chlor-a/cm2	Phytoplanton, ug chl-a/L	Phytoplankton Phaeophytin, ug chlor-a/L
STATIONS BELOW DISCHARGE																		
Muni Golf	SJCCBPC	11/7/00	9:50	12.3	7.4	8.3	14.40	1157	1.60	<0.1	<.01	83	nc	19	14.1	10.0	3.1	0.0
Penitencia Creek	SJPC	11/7/00	10:34	12.6	8.3	11.5	3.20	555	1.40	<0.1	<.01	20	nc	5	121.9	23.3	12.3	2.1
Watson Park Down	SJCCBSMC	11/7/00	11:10	13.7	7.8	7.0	18.60	1275	1.10	<0.1	0.02	70	nc	33	nc	nc	3.2	0.0
San Miguelita Creek	SJSMC	11/7/00	11:42	14.0	8.0	10.0	23.90	1623	6.70	<0.1	0.11	3	nc	47	133.7	40.8	3.2	0.0
Watson Park Up	SJCCASMC	11/7/00	11:34	13.4	7.5	4.2	9.10	908	1.10	<0.1	0.12	85	nc	13	nc	nc	2.3	0.0
Stonegate	SJCCBDis	11/7/00	12:30	12.3	7.9	8.6	8.20	569	3.80	<0.1	0.12	77	nc	10	14.0	11.8	1.4	0.0
STATION ABOVE DISCHARGE																		
Singleton Upstream	SJCCADis	11/7/00	1:15	12.7	7.9	7.7	6.40	528	0.21	<0.1	<.01	56	nc	7	nc	nc	7.2	0.1
Hellyer Park	SJCCHel	11/7/00	1:30	12.6	7.9	8.4	4.40	528	3.20	<0.1	0.11	78	nc	5	19.3	4.5	1.5	0.0

Field Data Entered By: JLH

Nutrient and Turbidity Analysis Performed By CSJ Lab   by CSJ Lab

N/A = Not Applicable

N/C = Not Collected

B = Boulder, C = Cobble, G = Gravel, M = Silt, R = Rock, S = Sand

Appendix III-B: Data Collected by the City of San Jose in 2001

Table III-B Coyote Creek Water Quality Data Submitted by the City of San Jose Sampling Period: June-November, 2001

Location	Date	Time	Temp (oC)	pH	DO (mg/L)	Turbidity (NTU)	TSS (mg/L)	TDS (mg/L)	NO3 (mg/L-N)	NO2 (mg/L-N)	Total Ammonia (mg/L-N)	TPHOS (mg/L-P)	OPHOS (mg/L-P)	SRP (mg/L-P)	DOC (mg/L)	TOC (mg/L)	BOD (mg/L)
Bernal	7/18/01	7:30	20.3	7.8	7.4	8.0	13	320	1.2	ns	<0.1	0.069	<0.010	ns	1.7	2.3	<2
Bernal	8/22/01	9:55	20.6	8.1	8.0	10.0	10	320	1.2	0.05	<0.1	<0.010	<0.010	<0.010	2.3	2.1	ns
Bernal	9/26/01	10:15	19.4	7.8	8.3	8.0	9	290	1.6	0.05	<0.1	<0.010	<0.010	<0.010	2.2	2.0	<2
Bernal	10/24/01	10:35	15.9	8.0	9.5	8.7	9	300	2.3	0.004	<0.1	0.036	0.029	0.028	1.7	2.0	<2
Bernal	11/14/01	11:15	15.4	7.8	9.9	4.6	6	320	2.4	0.005	<0.1	0.010	0.011	<0.010	<1.0	1.8	<2
Hellyer	6/27/01	10:00	22.0	7.7	5.2	10.0	19	340	0.3	ns	<0.1	0.030	0.014	ns	3.6	4.5	<2
Hellyer	7/18/01	8:50	21.1	7.6	6.0	7.2	9	330	0.2	ns	<0.1	0.037	<0.010	ns	2.4	2.9	<2
Hellyer	8/22/01	9:30	20.7	8.1	6.8	17.2	17	340	0.2	<0.05	<0.1	0.032	0.011	<0.010	3.0	3.3	ns
Hellyer	9/26/01	9:30	19.1	7.9	6.6	12.1	15	300	0.7	<0.05	<0.1	0.043	0.017	0.015	5.9	4.9	3
Hellyer	10/24/01	9:45	15.6	7.9	7.8	13.3	15	300	1.1	0.006	<0.1	0.051	0.041	0.037	2.3	2.8	<2
Hellyer	11/14/01	9:30	14.5	7.3	7.2	13.1	15	270	1.4	0.01	<0.1	0.058	0.030	0.019	4.1	5.0	2
Metcalf Up	7/18/01	8:00	18.6	7.4	6.9	5.2	9	310	1.7	ns	<0.1	0.025	<0.010	ns	1.4	2.0	<2
Metcalf Up	8/22/01	10:20	18.5	7.6	7.9	3.5	5	300	1.8	<0.05	<0.1	0.010	0.011	<0.010	2.2	1.9	<2
Metcalf Up	9/26/01	10:45	18.1	7.6	7.8	3.6	5	290	2.4	<0.05	<0.1	<0.010	<0.010	<0.010	1.7	1.4	<2
Metcalf Up	10/24/01	11:00	15.9	7.6	7.4	3.7	5	260	2.8	0.004	<0.1	0.032	0.028	0.027	1.6	1.6	<2
Metcalf Up	11/14/01	10:30	16.0	7.3	8.0	3.8	7	320	2.7	0.005	<0.1	0.024	0.019	0.015	1.6	1.6	<2
Muni Golf	6/28/01	10:12	19.6	7.7	3.4	6.3	11	720	0.5	ns	0.7	0.210	0.130	ns	21.1	23.9	7
Muni Golf	7/19/01	7:20	20.0	7.9	7.4	13.2	21	700	2.6	ns	0.1	0.130	0.095	ns	2.3	3.4	<2
Muni Golf	8/23/01	7:35	19.5	7.9	6.9	23.5	27	790	2.7	<0.05	<0.1	0.170	0.140	0.110	3.2	3.8	ns
Muni Golf	9/27/01	7:30	18.8	7.8	5.3	15.2	20	740	2.3	0.07	0.2	0.150	0.100	0.092	10.5	10.7	3
Muni Golf	10/25/01	7:30	15.0	8.0	8.2	14.2	18	640	2.7	0.019	<0.1	0.130	0.099	0.097	2.8	3.0	<2
Muni Golf	11/15/01	7:40	15.1	7.2	6.8	19.6	22	620	2.4	0.046	<0.1	0.180	0.130	0.110	6.7	7.3	<2
Reservoir	6/27/01	10:45	24.4	7.2	7.2	0.7	<2	740	7.2	ns	<0.1	0.440	0.370	ns	6.8	7.6	<2
Reservoir	7/18/01	9:40	23.0	7.1	7.4	0.5	<4	720	6.7	ns	<0.1	0.290	0.210	ns	6.6	6.9	2
Reservoir	8/22/01	9:00	25.2	7.1	7.4	0.7	<2	720	9.0	<0.05	<0.1	0.590	0.460	0.430	7.5	7.9	ns
Reservoir	9/26/01	9:05	25.0	7.2	7.2	1.0	<2	700	8.0	<0.05	<0.1	0.490	0.038	0.035	7.3	6.8	<2
Reservoir	10/24/01	9:15	22.6	7.3	7.2	0.7	<2	800	11.8	<0.003	<0.1	1.500	1.200	1.200	7.1	7.5	<2
Reservoir	11/14/01	9:00	23.6	7.2	7.2	0.9	<2	780	10.4	0.004	<0.1	0.740	0.670	0.670	6.1	6.5	<2
San Miguelita	6/28/01	9:06	19.6	7.9	7.7	17.2	33	1010	5.2	ns	0.3	0.400	0.110	ns	6.5	7.7	<2
San Miguelita	7/19/01	9:35	19.7	7.9	8.3	16.2	29	980	5.9	ns	0.1	0.100	0.075	ns	2.2	3.2	<2
San Miguelita	8/23/01	10:00	19.9	8.1	8.1	45.4	55	960	6.0	<0.05	<0.1	0.150	0.099	0.076	3.0	4.0	ns
San Miguelita	9/27/01	9:30	18.5	8.0	7.8	39.4	53	940	7.7	0.05	<0.1	0.180	0.140	0.110	5.0	6.0	3
San Miguelita	10/25/01	9:40	14.8	8.1	9.2	31.4	45	940	7.0	0.04	<0.1	0.120	0.110	0.110	3.3	5.6	5
San Miguelita	11/15/01	9:55	15.7	7.9	9.1	37.0	48	970	6.0	0.086	<0.1	0.190	0.130	0.110	3.3	4.4	<2
Singleton	6/27/01	11:20	21.5	7.8	5.2	11.0	14	370	0.2	ns	<0.1	0.050	0.040	ns	4.8	5.6	<2
Singleton	7/18/01	10:10	20.1	7.8	7.3	7.6	11	360	0.2	ns	<0.1	0.053	0.028	ns	2.5	3.3	<2
Singleton	8/22/01	8:20	20.3	8.0	7.5	13.6	15	350	0.1	<0.05	<0.1	0.031	0.018	0.016	3.2	3.3	<2

Table III-B Coyote Creek Water Quality Data Submitted by the City of San Jose — Sampling Period: June-November, 2001

Location	Date	Time	Temp (oC)	pH	DO (mg/L)	Turbidity (NTU)	TSS (mg/L)	TDS (mg/L)	NO3 (mg/L-N)	NO2 (mg/L-N)	Total Ammonia (mg/L-N)	TPHOS (mg/L-P)	OPHOS (mg/L-P)	SRP (mg/L-P)	DOC (mg/L)	TOC (mg/L)	BOD (mg/L)
Singleton	9/26/01	8:05	18.4	7.8	7.4	11.8	14	310	0.6	<0.05	<0.1	0.061	0.035	0.031	4.4	4.6	2
Singleton	10/24/01	8:15	14.7	8.0	8.8	9.4	10	340	0.8	0.006	<0.1	0.055	0.051	0.048	2.6	3.0	<2
Singleton	11/14/01	8:15	14.5	7.3	7.3	40.1	36	290	1.0	0.02	<0.1	0.130	0.074	0.054	6.4	8.5	3
Stonegate	6/27/01	12:35	21.2	7.5	5.3	14.5	20	420	0.2	ns	<0.1	0.100	0.068	ns	9.4	10.5	<2
Stonegate	7/18/01	10:50	19.6	7.6	7.6	17.7	25	380	0.3	ns	<0.1	0.070	0.042	ns	2.4	3.9	<2
Stonegate	8/22/01	7:56	19.3	8.0	7.3	27.1	31	360	0.1	<0.05	<0.1	0.067	0.048	0.036	3.6	3.6	<2
Stonegate	9/26/01	7:35	18.2	7.7	6.7	20.8	23	340	0.9	<0.05	<0.1	0.070	0.043	0.035	6.3	6.1	2
Stonegate	10/24/01	7:45	14.7	8.0	8.3	14.4	16	360	0.6	0.004	<0.1	0.072	0.048	0.044	2.8	2.9	<2
Stonegate	11/14/01	7:45	14.7	7.1	6.9	28.2	24	300	1.0	0.019	<0.1	0.140	0.079	0.064	7.9	11.0	8
TPS	6/28/01	10:58	25.1	6.6	5.3	0.6	<2	760	8.6	ns	0.3	0.370	0.250	ns	7.9	8.4	<2
TPS	7/19/01	10:20	25.3	6.6	5.7	0.9	<4	730	8.5	ns	0.1	0.260	0.200	ns	6.8	8.2	<2
TPS	8/23/01	10:45	25.8	6.8	6.2	0.8	<2	770	10.2	<0.05	<0.1	0.660	0.580	0.560	8.1	8.0	ns
TPS	9/27/01	10:15	25.4	6.7	5.7	1.7	<2	710	7.8	<0.05	0.1	0.750	0.580	0.460	7.6	7.6	2
TPS	10/25/01	10:15	24.4	6.5	6.0	0.2	<2	1600	15.5	<0.003	<0.1	1.900	1.400	1.400	8.9	8.9	3
TPS	11/15/01	10:30	23.6	6.7	6.0	1.0	<2	790	13.8	<0.003	<0.1	1.200	0.990	0.980	8.2	7.8	2
Penitencia	6/28/01	9:40	19.4	8.4	10.7	4.6	8	300	0.1	ns	0.1	0.050	0.031	ns	4.5	5.1	<2
Penitencia	7/19/01	8:00	18.5	7.7	9.3	10.4	8	220	0.2	ns	0.1	0.063	0.055	ns	2.3	2.8	<2
Penitencia	8/23/01	8:05	19.3	8.1	9.4	4.1	3	340	<0.1	<0.05	<0.1	0.038	0.038	0.036	2.5	2.6	ns
Penitencia	9/27/01	8:00	17.6	7.8	9.1	3.8	4	380	0.1	<0.05	0.2	0.045	0.041	0.040	2.9	2.9	<2
Penitencia	10/25/01	8:00	14.4	7.6	10.1	7.9	12	360	0.3	0.004	<0.1	0.078	0.066	0.063	2.9	2.6	<2
Penitencia	11/15/01	8:15	14.2	7.7	10.4	11.8	23	330	0.5	0.004	<0.1	0.089	0.058	0.051	3.0	3.4	<2
Watson Down	6/28/01	8:20	19.4	7.5	3.4	14.8	24	820	2.9	ns	<0.1	0.350	0.180	ns	22.0	28.6	13
Watson Down	7/19/01	9:00	19.2	7.8	6.0	15.3	25	850	3.8	ns	0.2	0.140	0.098	ns	2.8	3.7	<2
Watson Down	8/23/01	9:30	19.1	7.9	5.2	28.7	38	870	3.5	0.2	<0.1	0.220	0.150	0.110	3.6	4.9	ns
Watson Down	9/27/01	9:00	18.2	7.8	3.8	28.7	38	730	3.2	0.16	0.2	0.220	0.140	0.110	12.9	14.1	5
Watson Down	10/25/01	9:00	14.6	7.7	6.9	24.0	30	770	4.5	0.033	0.1	0.130	0.120	0.120	3.2	3.6	2
Watson Down	11/15/01	9:15	15.0	7.6	5.2	21.9	27	680	3.0	0.055	<0.1	0.220	0.150	0.130	6.8	8.1	2
Watson Up	6/28/01	8:45	19.5	7.2	0.2	13.6	20	600	0.1	ns	0.2	0.580	0.410	ns	40.1	53.2	26
Watson Up	7/19/01	9:20	18.9	7.6	3.6	10.0	13	670	1.2	ns	0.3	0.150	0.130	ns	3.2	4.5	<2
Watson Up	8/23/01	9:45	18.6	7.6	1.1	11.2	12	700	<0.1	0.34	<0.1	0.310	0.180	0.170	4.4	5.9	ns
Watson Up	9/27/01	9:15	18.0	7.4	0.3	13.7	19	570	0.5	0.26	0.4	0.260	0.160	0.140	18.4	20.2	8
Watson Up	10/25/01	9:15	14.5	7.5	4.3	13.1	14	530	1.1	0.025	0.1	0.130	0.110	0.120	3.7	3.7	<2
Watson Up	11/15/01	9:40	14.7	7.2	2.7	10.1	10	490	1.1	0.034	<0.1	0.250	0.160	0.150	8.6	9.8	3

Appendix III-C: Data Quality issues identified by CSJ for general water quality and nutrient analyses

2001 Streamflow Augmentation Pilot Project
Data Quality Issues for General Water Quality and Nutrient Analyses

Potential data-quality-control issues were identified for seven “general water quality” and “nutrient” parameters for the 2001 monitoring season.

1. Alkalinity: The field blank collected 8/23/01 (sample # 01-235-CC-QCJ) had a result of 4 mg/L. This was likely “noise” in the method. Since it represented 4.4% and 2.7% of the lowest and second-lowest field values for that sampling event, its effect on data quality is likely to be negligible.

2. Ammonia: The 0.1 mg/L analytical standard run 9/28/01 had 27% error (too high). This affected samples collected 9/28/01 for Muni Golf, Upper Penetencia, Watson Pk. Down, San Miguelita, Watson Pk. Up, TPS (recycled water), and the field blank. Since San Miguelita and the field blank had results of < 0.1 mg/L, they do not appear to have been affected by this error. However, the remaining stations had results of 0.1 to 0.4 mg/L and some or all of these may be biased on the high side. In particular, the Watson Park Up result of 0.4 mg/L should be flagged as questionable especially if this ammonia value exceeds the criterion.

3. DOC: a. Three stations (Metcalf, Bernal & TPS) in the August sampling event had DOC results > TOC. Since TSS for these stations was 5, 10 and <2 mg/L, respectively, and since the absolute differences were only 0.1-0.3 mg/L, this is not viewed as a significant issue.

   b. Upper Penetencia Station had a DOC of 2.9 mg/L and a TOC of 2.6 mg/L for the October event (TSS=12mg/L).

   c. TPS had a DOC of 8.2 mg/L and a TOC of 7.8 mg/L for the November event (TSS<2mg/L).

4. Nitrate: For the June event, all samples were held for 8 days before analysis in-house (method calls for a 48-hr hold time). To be consistent, we opted to retain the In-house data even though we had Sequoia lab data for analyses that were completed within the proper holding time. A comparison of the two data sets (In-House & Sequoia) for all non-detect values for the June event were as follows:

Sample	Sequoia	In-House
01-178-CC-093C(B)	7.2 mg/L	7.3 mg/L
01-178-CC-033C(B)	2.9 mg/L	2.9 mg/L
01-178-CC-043C(B)	5.2 mg/L	5.4 mg/L
01-178-CC-103C(B)	8.6 mg/L	8.9 mg/L

Nitrate: July samples collected 7/18/01 & 7/19/01 were analyzed on 7/24/01 after the standard 48-hour holding time (see further comment below).

Nitrate: October samples collected 10/24/01 & 10/25/01 were analyzed on 10/29/01 after the standard 48-hour holding time (see further comment immediately below).

Chemist Michael Chiang who performed the nitrate analyses in-house indicated that the extended holding times were not a problem. To prove his point he re-analyzed November samples in December and reported the following results (in mg/L).

Sample	Sample Date	Analyzed 11/16/01	Analyzed 12/20/01
01-318-CC-123B	11/14/01	2.7	2.6
01-318-CC-113B	11/14/01	2.4	2.3
01-318-CC-093B	11/14/01	10.4	10.6
01-318-CC-083B	11/14/01	1.4	1.4
01-318-CC-073B	11/14/01	1.0	1.0
01-318-CC-063B	11/14/01	1.0	1.1

5. Phosphorus: In August, Metcalf had an Ortho-P (0.011 ppm) > total P (0.010 ppm).
In October, Watson Park Up had an SRP (0.12 ppm) > Ortho-P (0.11 ppm)
In November, Bernal had an Ortho-P (0.011 ppm) > total P (0.010 ppm)

6. TKN: In September, nine station samples (Stonegate, Singleton, Hellyer, Reservoir, Bernal, Metcalf, Muni Golf, Upper Pen., Watson Down) had a matrix spike/spike duplicate RPD of 27.8% (a bit high).
The analysis for four samples (San Miguelita, Watson Up, TPS, Field Blank) had an analytical blank result of 0.6 ppm (very high). The field blank was not affected by this (result <0.4). The other 3 stations had results > PQL of 0.4 and thus may have been affected by this high analytical blank (contamination).

7. Turbidity: In August and October, the field blank for turbidity was at the reporting limit of 0.1 NTU rather than below it (<0.1).

In November, the field blank was 0.4 NTU. All results were greater than 10X this contamination except for the recycled water at the TPS & Reservoir stations.

In November, the Watson Up station sample was analyzed 2 days beyond the standard holding time of 48 hours. Since Watson Down turbidity was reported as 21.9 NTU and San Miguelita turbidity was 37.0 NTU, the result of 10.1 NTU for Watson Up appears to be reasonable (i.e. not affected by holding time).

Appendix III-D: Chlorophyll data determined by SJSU

Table III-D. Coyote Creek Chlorophyll, Velocity, and Discharge Data Submitted by SJSU

Site	Date	Phytoplankton (ug/L)	Attached algae (ug/cm2)	Velocity (fps)	Discharge (cfs)
Bernal	07/19/01	5.13	39.36	1.66	11.8
Bernal	08/21/01	4.17	33.06	2.45	14.3
Bernal	09/27/01	3.53	82.79	2.12	13.4
Bernal	10/24/01	3.27	15.10	1.72	10.3
Bernal	11/14/01	2.13	12.77	2.25	14.7
Hellyer	07/19/01	19.79	45.04	1.4	2.8
Hellyer	08/21/01	16.05	17.54	1.47	4.6
Hellyer	09/27/01	13.71	44.28	2.15	6.3
Hellyer	10/24/01	15.71	15.1	1.6	2.6
Hellyer	11/14/01	1.71	4.16	1.87	7.1
Metcalf	07/19/01	10.27	35.41	ns	ns
Metcalf	08/21/01	2.25	34.98	0.79	14.8
Metcalf	09/27/01	1.61	53.3	0.81	14.4
Metcalf	10/24/01	0.93	49.05	1.09	19.3
Metcalf	11/14/01	0.76	25.74	1.03	17.9
Muni Golf	07/19/01	17.12	22.48	1.49	15.0
Muni Golf	08/21/01	9.09	30.49	1.2	10.9
Muni Golf	09/27/01	8.23	36.38	1.37	13.3
Muni Golf	10/24/01	4.13	72.76	1.1	11.3
Muni Golf	11/14/01	2.79	4.86	1.77	21.5
Penitencia	07/19/01	25.21	87.3	1.42	3.5
Penitencia	08/21/01	19.49	159.39	0.99	2.1
Penitencia	09/27/01	12.25	53.81	0.71	1.1
Penitencia	10/24/01	12.48	55.74	0.48	0.8
Penitencia	11/14/01	5.27	8.72	1.26	3.7
San Miguelita	07/19/01	28.88	51.77	0.57	8.1
San Miguelita	08/21/01	8.83	66.53	0.54	4.9
San Miguelita	09/27/01	7.66	27.87	0.75	8.2
San Miguelita	10/24/01	9.88	37.9	0.37	3.3
San Miguelita	11/14/01	4.94	13.88	0.71	7.0
Singleton Up	07/19/01	5.99	ns	ns	ns
Singleton Up	08/21/01	19.75	ns	ns	ns
Singleton Up	09/27/01	9.15	ns	ns	ns
Singleton Up	10/24/01	2.59	ns	ns	ns
Singleton Up	11/14/01	3.04	ns	ns	ns
Stonegate	07/19/01	3.43	25.35	0.37	3.6
Stonegate	08/21/01	3	34.23	0.28	2.7
Stonegate	09/27/01	5.41	27.16	0.45	6.4
Stonegate	10/24/01	1.65	26.75	0.32	3.0
Stonegate	11/14/01	1.52	23.98	0.61	6.2
Watson Down	07/19/01	16.5	ns	0.36	11.2
Watson Down	08/21/01	8.02	ns	0.32	11.8
Watson Down	09/27/01	7.72	ns	0.29	11.1
Watson Down	10/24/01	7.35	ns	0.33	12.8
Watson Down	11/14/01	2.28	ns	0.41	15.4
Watson Up	07/19/01	5.89	ns	0.29	5.1
Watson Up	08/21/01	1.6	ns	0.12	5.6
Watson Up	09/27/01	2.16	ns	0.19	9.5
Watson Up	10/24/01	4.35	ns	ns	ns
Watson Up	11/14/01	1.82	ns	0.3	13.9

Appendix III-E: Chlorophyll ranking and prediction data for 2000 data determined by SJSU

SUMMARY OF 2000 ALGAE GROWTH DATA

When analyzing 2000 data, a ranking of water quality parameters associated with attached algae growth using the data provided in Appendix III-A was made. These results are repeated in Table III-E1. The higher the total ranking, the least likely algae were to grow at the site. The order of sites from those where attached algae was most likely to grow to those where attached algae was least likely to grow in 2000 follows:

Penitencia Creek > San Miguelita Creek > Hellyer > Singleton Up = Stonegate = Muni Golf > Watson Down > Watson Up

The results of this analysis and a ranking of the sites with respect to attached algae growth measured during the 2000 sampling period are compared in Table III-E2. Sites tended to fall into three distinct categories: (A) those with conditions highly conducive to attached algae growth, (B) those with variable conditions that are moderately conducive to attached algae growth and (C) those with conditions prohibitive to attached algae growth.

Table III-E1. Ranking of water quality parameters associated with attached algae growth that were measured from multiple locations along Coyote Creek and its tributaries between May - November, 2000.

Site	pH	D.O	Canopy Cover	Turbidity	Velocity	Water Temp.	Substrate Type***	Total Rank
Hellyer	3**	3	5	2	4	2	2	21
Singleton Up	5	5	3	3	8	3	4	31
Stonegate	4	4	4	6	5	6	3	31
Watson Up	8	8	8	4	7	8	4	47
San Miguelita Creek	2	2	1	8	2	4	1	20
Watson Down	7	7	7*	7	6	7	4	45
Penitencia Creek	1	1	2	1	3	1	1	10
Muni Golf	6	6	6*	5	1	5	2	31

*averages were equal, ranking based on range of values
**1= highest impact on algae growth; 5 = less impact on algae growth.
***Substrate boulder/cobble = 1; cobble/gravel = 2; gravel/sand = 3; sand/silt = 4.

Table III-E2. Comparison of rankings for actual (chlorophyll a) and predicted (growth category) values for attached algae growth in Coyote Creek and its tributaries.

SITE	RANK BASED ON ATTACHED CHLOROPHYLL a	ATTACHED GROWTH CATEGORY
Hellyer	5	A
Singleton Up	8*	B
Stonegate	4	B
Watson Up	8	C
San Miguelita Creek	1	A
Watson Down	8	C
Penitencia Creek	2	A
Muni Golf	3	B

Rank of 8 indicates no attached algae were observed.

In general, the actual and predicted amounts of algae growth were the same for the extreme conditions, *i.e.*, conditions conducive to growth and conditions prohibitive to growth. The exception for the (A) ranked sites was that for Hellyer. The actual ranking was not unexpected in that although algae were always present, and the site parameters were conducive to algae growth. The algae were scruffy and unhealthy looking, presumably as a result of the presence of large numbers of invertebrates that wove the algae into nets. As a result, the lowest chlorophyll measurements were measured at this site of the five sites with attached algae, resulting in a rank of 5. It was hypothesized that if the invertebrates were not present, much higher concentrations of chlorophyll would have been measured. The Singleton site was placed in category B, however attached algae were never observed. The absence of attached algae at this site is attributed to a lack of substrate for algae attachment. As discussed in the site description, attached algae grew on rocks located below the transect. In addition, algae grew below the storm drain discharge point where obvious substrate changes occurred. The qualitative assessment does indicate that for the most part, attached algae are not likely to be a concern in most of Coyote Creek, unless conditions change resulting in enhanced growth conditions, *e.g.*, increased substrate for attachment or light become available.

Table III-E3 provides a ranking of algae growth (attached or planktonic) measured from multiple locations along Coyote Creek and its tributaries between May and November, 2000. Note that sites with attached algae growth tended to have decreased planktonic algae growth; albeit planktonic algae concentrations were always very low.

Table III-E3. Ranking of algae growth measured from multiple locations along Coyote Creek and its tributaries between May – November, 2000. 1= highest level of algae growth. Note: For attached algae, a score of 8 indicates no growth.

Site	Chlorophyll a, attached	Chlorophyll a, planktonic
SJCCHel	5	3
SJCCADis	8	1
SJCCBDis	4	4
SJCCASMC	8	2
SJSMC	1	7
SJCCBSMC	8	5
SJPC	2	8
SJCCBPC	3	6

Chapter IV. Conclusions and Recommendations

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CHAPTER IV. CONCLUSIONS AND RECOMMENDATIONS

Coyote Creek currently provides warm water habitat to a variety of aquatic species. Following implementation of stream augmentation activities, Coyote Creek may provide cold water habitat as well. Additions of recycled water are expected to act beneficially in several ways, including but not limited to the flushing of fine particulates, the removal of debris, the increase of flow within the Creek and, potentially, the provision of habitat to anadromous fish. Deleterious impacts of increased flows may include increased loading of dissolved inorganics (*e.g.,* nutrients and metals such as zinc) and incidences of algae blooms (resulting in low concentrations of dissolved oxygen, elevated pH and increased concentrations of un-ionized ammonia). Recently, concerns related to the potential impacts of *N*-Nitrosodimethylamine (NDMA), a nitrosamine classified by the US Environmental Protection Agency (USEPA) as a probable human carcinogen (Choi and Valentine, 2002), pharmaceuticals (USGS, 2002), and of endocrine disruptors (Trussell, 2001) have had major impacts on the public's perception of water reuse. These latter issues, if not addressed carefully and with full public participation, are likely to prevent or slow the progress of the Coyote Creek stream augmentation project.

Conclusions and recommendations specific to data collected during the sampling period of June to November of 2001 are summarized below.

Conclusions

Data generated in this study during the 2001 sampling period indicate the following:

- Nitrate-nitrogen was the dominant form of nitrogen throughout the monitoring period at all stations. The nitrate concentrations were high, particularly during the time period proposed for augmentation. The lowest concentrations measured were sufficient to saturate algae enzyme systems.
- Maximum planktonic algae growth occurred in the late winter/early spring months, when nitrogen concentrations are low; additions of nutrient-rich water during this time period could enhance planktonic algae growth.

- Total ammonia concentrations were higher in 2001 than in 2000. Concentrations at sites above Watson Up were typically less than the Practical Quantitation Limit (PQL) whereas elevated total ammonia concentrations were common downstream of the Watson Up site.
- During sampling events, the CCC for total ammonia was never exceeded. However, conditions of algae growth, increased light penetration, variability in sampling time (seasonal and diel), and numerous other factors could result in minor increases in pH and/or temperature that would cause the ammonia levels to exceed the criterion (CCC). Under existing creek conditions, the potential to exceed the ammonia criterion in Coyote Creek does not appear to be great since sites with the highest ammonia concentrations (*e.g.*, Muni Golf) typically did not have the highest pH values. Nonetheless, creek conditions following augmentation will have a greater potential for ammonia concentrations to exceed the CCC.
- Attached algae were not significant at sampling sites where the substrate was primarily sand and silt. The presence of gravel and cobbles within a reach generally resulted in the presence of attached algae, however nuisance levels were never observed. Attached algae biomass is low relative to other urban creeks; growth appears limited by substrate availability for attachment or sunlight.
- Planktonic algae concentrations at some sites (e.g., Hellyer and Singleton) were in the range of a mesotrophic to eutrophic system. Stations characterized by low flow velocity had elevated concentrations of phytoplankton, possibly a result of increased time for growth within a reach.
- A decrease in planktonic chlorophyll-a was measured at all creek sites in 2001 relative to 2000, with the lowest concentrations of planktonic algae biomass measured at Stonegate and Watson Up. Concentrations increase at Watson Down and Muni Golf, in response to elevated concentrations in the tributaries.

- In general, many sites had oxygen concentrations lower than the minimum concentration required for a cold water fish habitat (7.0 mg/L as O_2 for tidal waters in the Bay downstream of Carquinez Bridge, CRWQCB-SFBR, 1986). This was particularly evident at Watson Up.

In summary, the discharge of recycled water into Coyote Creek could result in increased algae growth, increased nitrogen concentrations, and under conditions of elevated algal photosynthesis, increased concentrations of un-ionized ammonia. In addition, increased discharge into Coyote Creek could transport sediment fines downstream, resulting in an increase in available substrate for attached algae growth. It is important to note, however, that considerable gaps in knowledge about creek-specific algae nutrient limitations, seasonal (year-round) and diel variability, and discharges from unknown sources to Coyote Creek limit predictions on the impact of recycled water on Coyote Creek ecology.

Recommendations

The goal of this project (2000-2001) was to determine the impact of the addition of recycled water on water quality and algae growth in Coyote Creek, San Jose. To assist in meeting this goal, several data gaps identified previously (Williamson and Hopkins 2001), and reinforced in the current study, need to be addressed.

An assessment of algae growth potential in the laboratory using pure cultures and water from the creek with a) attached algae and b) planktonic algae should be completed. Combinations of nitrogen and phosphorus concentrations should be assessed for impact on algae growth. Dilutions of the creek water with recycled water to concentrations anticipated following augmentation should be completed. This assessment will address the potential enhancement (or toxicity) effects on algae growth by nutrients, micronutrients and growth factors in the recycled water.

A diel study of water quality parameters associated with algae growth should be completed in order to determine the potential for deleterious water quality conditions associated with algae growth (low dissolved oxygen, elevated pH, increased un-ionized ammonia concentrations). It is recommended that a diel study be implemented at three locations (*e.g.*, creek site with attached algae, creek site without attached algae, and tributary site with attached algae) during two time periods. Time periods of the diel investigations should be contingent on the presence of algae. Temperature, pH, dissolved oxygen, conductivity and nutrients should be collected a minimum of six times in each 24-hour period.

Discharge calculations are important for evaluation of the loading of water quality parameters to Coyote Creek from various discharges (*e.g.*, storm drains and/or tributaries). An explanation of discharge variability was confounded by difficulties in measuring discharge, by the existence of numerous storm drains and other non-point sources along the creek and by releases from the upstream reservoir. Discharges of point sources to Coyote Creek should be assessed by the appropriate agency.

The development of a comprehensive objective or management plan that integrates algae-controlling factors needs to be considered. This comprehensive objective could include numerical and/or narrative objectives for nutrient loading, riparian vegetation, erosion control, and flow. Control of the nutrient load (in contrast to nutrient concentrations in receiving waters) could reduce nutrients available for algae growth. Increased riparian vegetation and certain emergent/submergent macrophytes could reduce nuisance algae due to increased shade, cooler temperatures, and increased competition for available nutrients. Erosion control would preserve substrate quality and decrease turbidity, which may improve fishery habitat. Decreased turbidity might make conditions more favorable for algae growth in areas of low canopy cover. Increased flow would flush existing silt and clay from the creek, thereby preserving substrate quality. Increased flow could also reduce phytoplankton concentrations due to wash out.

The reach between Stonegate and Watson Up had elevated concentrations of total dissolved solids, nutrient concentrations (total phosphorus, soluble reactive phosphorus, orthophosphate, total ammonia, and nitrite nitrogen), total organic carbon, dissolved organic carbon, and biochemical oxygen demand relative to all other Coyote Creek sites. In addition, the turbidity and total suspended solids concentration at Watson Up were always lower than what was measured in the nearest upstream site (Stonegate), indicating either settling of solids or the input of water with fewer suspended solids. Likewise, the pH, dissolved oxygen, and percent oxygen saturation were always lower at Watson Up than at any other site. These data indicate an organic load to this reach of the creek. The chemical composition of whatever is being discharged at or above this site is unknown, but could include inhibitory substances. For these reasons, further investigation of the reach between Stonegate and Watson Up for the potential discharge of organic and/or inhibitory substances is recommended.

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